Computing today

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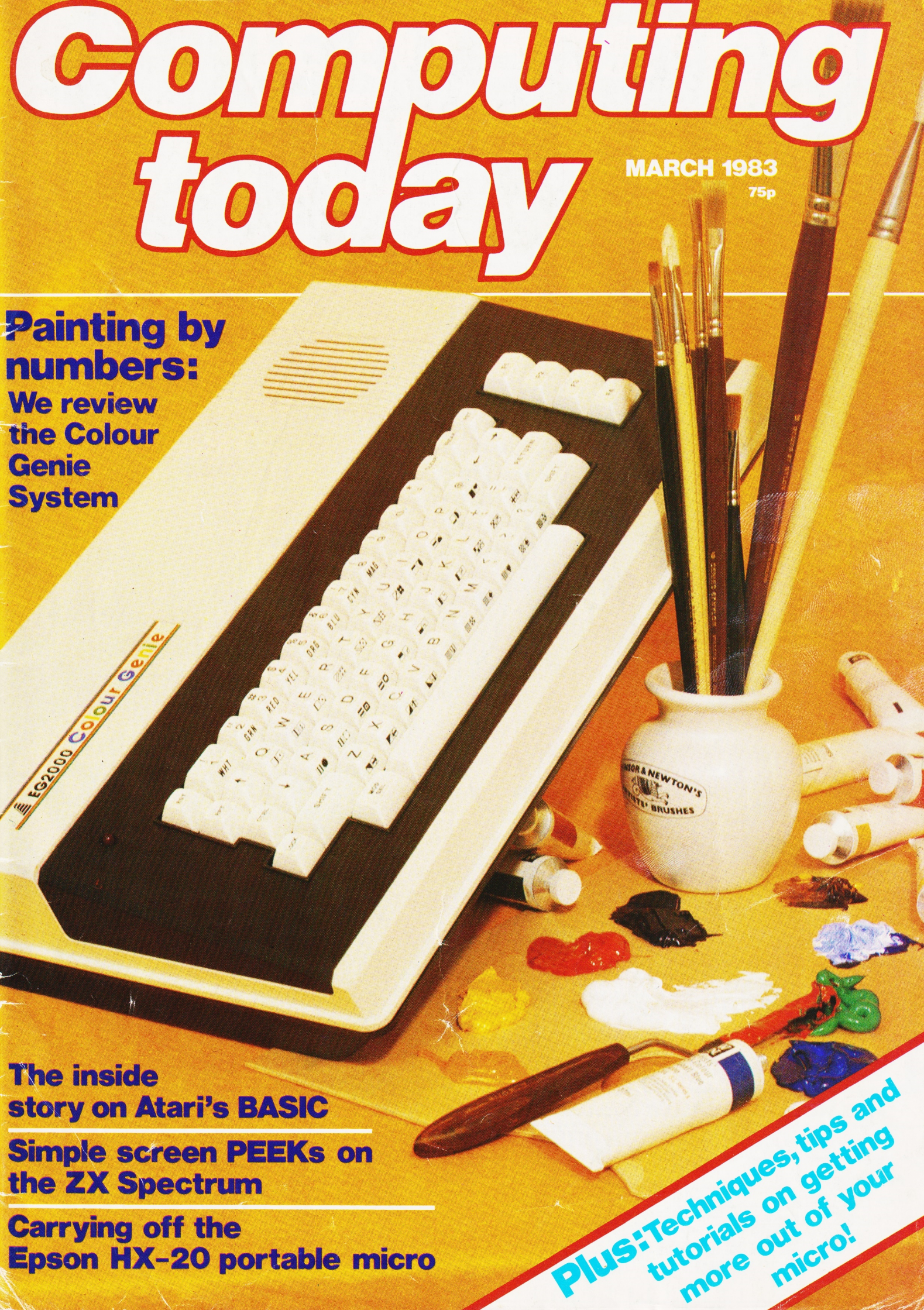

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.

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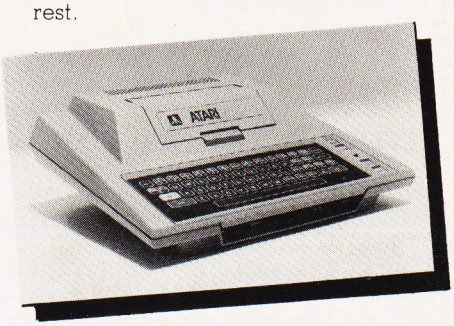

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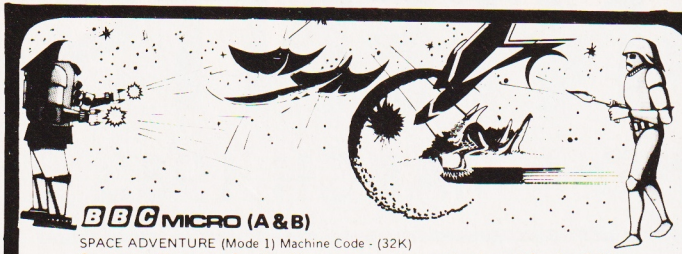

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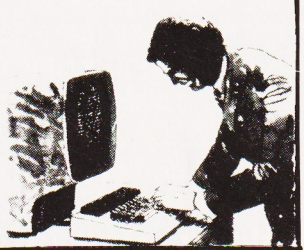

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CONSUMER NEWS

A MICRO WITH VISION ▲

A vision system has been announced from Digithurst which consists of a standard CCTV camera, camera/computer interface and vision software, and which uses a Microeye interface to send back images to a computer as eight-bit digital video.

The MicroSight system software consists of a set of command processor and disc handling routines plus six machine code routines to read in data and process it for display in high resolution graphics. Images are stored in the computer's RAM as run length encoded data.

MicroSight, which is aimed at the educational and R&D markets, can be used on any computer which has a high resolution graphics capability and an eight-bit parallel port. The system is priced at £495 plus VAT. Further details can be obtained from Digithurst Limited, Leaden Hill, Orwell, Royston, Hertfordshire SG8 5QH, or 'phone 0223-208926.

SPECTRUM IS LET OUT

The Sinclair Spectrum is indeed being let out form larger branches of W H Smith, although with this being the only high street outlet for what is Britain's fastest selling home computer I think it will be difficult to keep it in the shop!

The 16K Spectrum sells at £125 and the 48K version at £175 including VAT. An extensive range of software, including W H Smith's own-brand range is also available in larger branches together with a new W H Smith Computer Carry Console at £14.95. And of course a wide range of computer books and magazines can also be found.

ACE HIGH

No I haven't just got the winning hand in a game of five card brag, but I can reveal that the Jupiter Ace is being launched into the retail market following its mail order success. Micro Marketing have been appointed by Jupiter Cantab to handle the retail distribution of the computer and its software. At present, software is being developed and a wide range should be available at retailers by the time you read this.

For further details please write to Micro Marketing, 92-104 Carwath Road, London SW6, or 'phone 01-736 1683.

PORTABILITY AND VERSATILITY ▼

Yes, it's portable and versatile and it's the new personal computer from Casio, the PB100. Designed to appeal to beginners and nonspecialists in the art of computing, the PB100 comes with a well conceived instruction book with clear explanations to give a ready grasp of BASIC programming.

As supplied, the PB100 can handle up to 544 program steps, extended to 1568 with the addition

of the associated OR1 expansion RAM pack. A cassette interface, FA3, for storing programs is also available, and a special printer, FP12, is soon to be introduced. The Casio PB100 computer, complete with programming guide, has a recommended retail price of £79.95. The optional RAM pack is listed at £13.95, cassette interface at £25.95 and the printer is expected to have a price of £54.95. Further information is available from Casio Electronics Company Limited, Unit Six, 1000 North Circular Road, London NW2 7JD, or 'phone 01-450 9131.

SPEAK TO ME

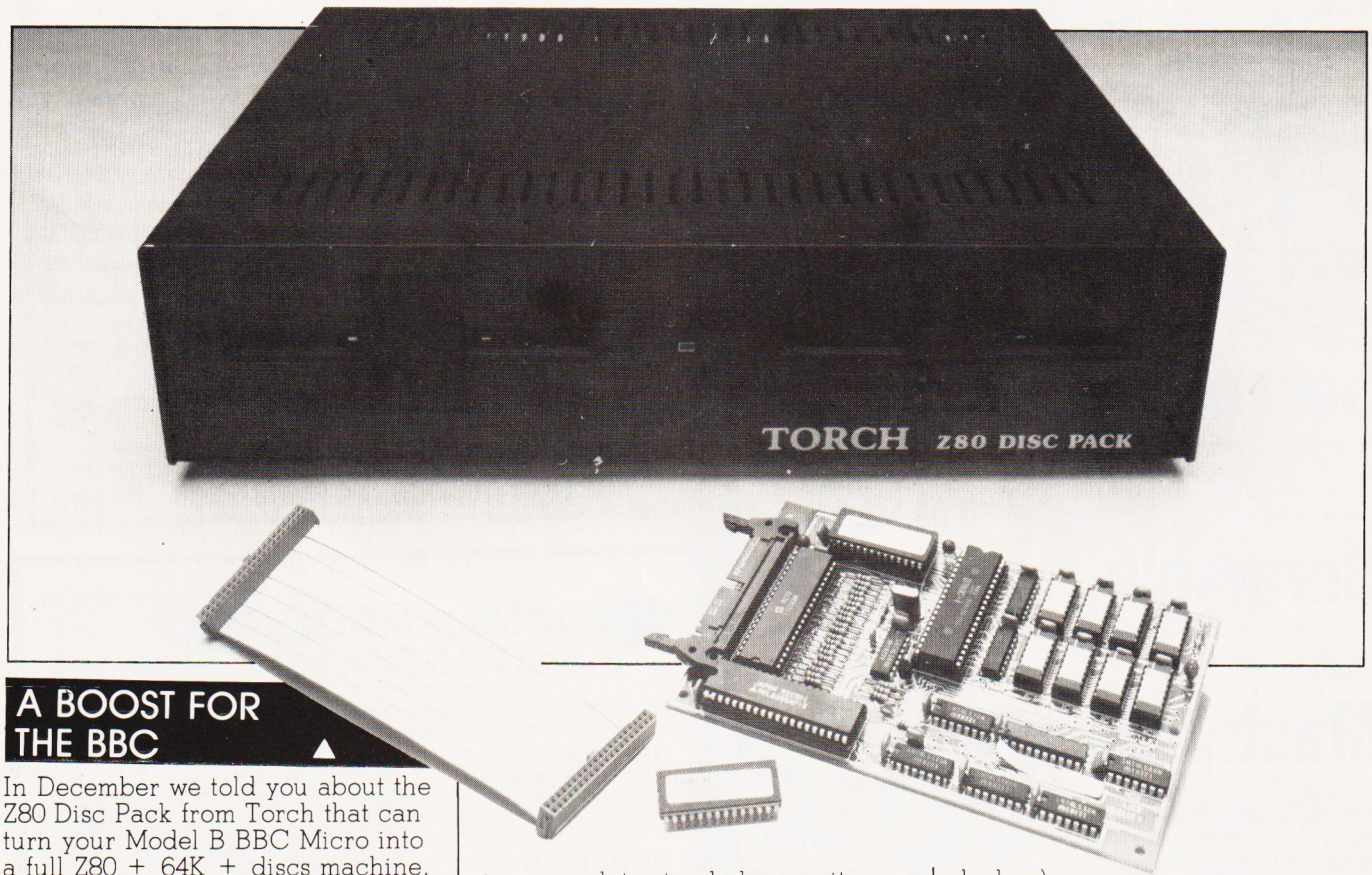
That is almost what you can get your computer to do with the help of the new Speech Synthesizers from Pete & Pam Computers. Echo II is and Apple II compatible plug-in card and Echo General Purpose is a complete stand alone unit.

The heart of both Echo synthesisers is a Texas Instruments chip which uses a model of the human vocal tract. This circuit using linear predictive coding, synthesises remarkably intelligible speech. The text-to-speech firmware allows the user to simply type in a word or phrase and let the computer do the rest. Nearly 400 grammatical rules are contained in the system and by using simple commands you can select any of 63 different base pitch levels and have words spoken either monotonically or with intonation. A phoneme generator is included with all Echo synthesizers. Echo II retails at £145 (£109 from dealers) and Echo General Purpose retails at £199 (£149 from dealers).

Pete & Pam Computers also announce the arrival of The Bufferboard, a Centronics compatible parallel buffer for the Apple II, II + or III computer. There are versions available for the Grappler/Grappler+, Epson, APL interface board and the Apple. The difference between the three different types of board available are the pin assignments and connectors. Only The Bufferboard has a simple Interface-Docking System; it comes standard with 16K and is expandable to 32K or 64K of buffering capacity with the addition of memory chips. The retail price is £99 (£79 from dealers).

Pete & Pam Computers have been awarded the distributorship of the Sweet-P Graphic Plotter by Enter Computers of San Diego. Sweet-P has plotting resolution that gives 250 line segments per inch and a drawing speed of 5" per second. You can use precision Sweet-P pens or one of the many commerically available pens in your local stationery shop, so the colours you can use is almost limitless, as is your choice of alphanumeric character size (⅛" to 20"). Sweet-P is compatible with the Apple, IBM and most other personal and small business computers. It is priced at £595.

For further details on any of the above products, write to Pete & Pam Computers, New Hall Hey Road, Rossendale, Lanchashire BB4 6JG, or 'phone 0706-227011.



A BOOST FOR THE BBC

In December we told you about the Z80 Disc Pack from Torch that can turn your Model B BBC Micro into a full Z80 + 64K + discs machine. Well now you can get the pack for only £895 including VAT, so if you would like more details write to Torch Computers Limited, Abberley House, Great Shelford, Cambridge CB2 5LQ, or 'phone 0223-841000.

DOUBLE VISION

Serving the valuable area of software duplication is Dataclone, which opened a new plant in November. Being the only company at present to use custom-built equipment, rather than using systems designed for the mass production of musicassettes, DataClone offer the following: low speed, high quality cassette duplication, EPROM copying and a translation service for adapting programs to different computers. Prices vary depending on quantity and specific requirements, but for a run of 500-1,000 duplicated cassettes, the cost would be approximately 45p per cassette. Further details can be obtained from DataClone, 1-7 Harewood Avenue, London NW1 6LE, or 'phone 01-724 3768.

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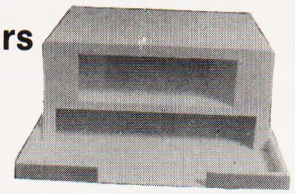

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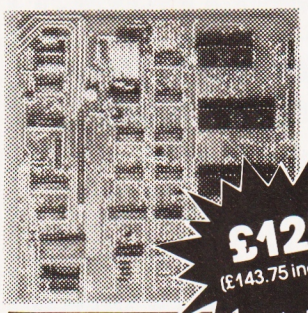
With MultiBoard an almost unlimited number of system permutations are possible. Seven of the most popular boards are shown here, but there is a range of 15 available from your MicroValue dealer; together with mother boards, frames, cables, power supplies, keyboards and compatible software if required.

Your MicroValue dealer can advise you on suitable permutations to suit your requirements, whether building a system from scratch or expanding your Galaxy or Nascom computer.



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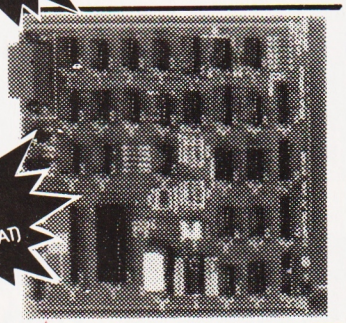

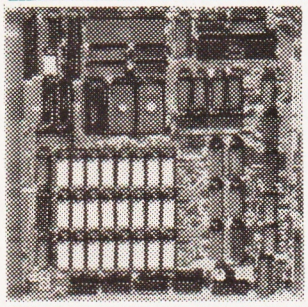

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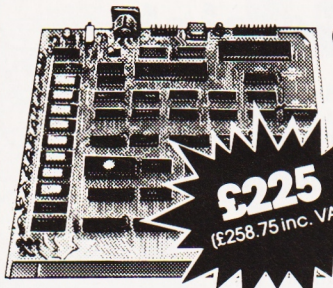


GM813 — CPU/64K RAM Board

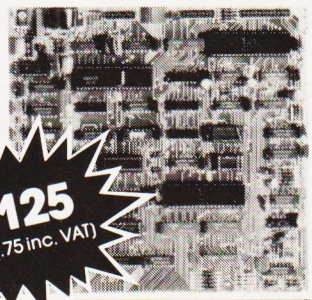
- 4 MHz Z80A CPU
- 64K Dynamic RAM
- RS232 Serial Interface
- Two 8-Bit I/O Ports
- 1200 Baud Cassette Interface
- Extended and Page Addressing Modes

£225 (£258.75 inc. VAT)

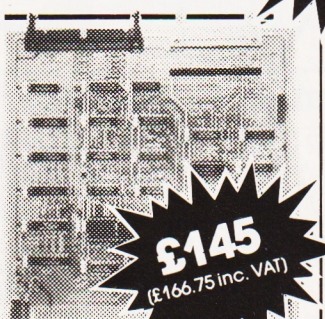
The Gemini GM813 is an 80-BUS compatible CPU card incorporating 64K dynamic RAM and utilising the powerful Z80A microprocessor running at 4MHz. Extended addressing and page mode facilities allow for future memory expansion up to 2 megabytes. Input and output capabilities include both programmable serial and parallel interfaces — RS232, 1200 baud CUTS cassette interface and the Z80A PIO. When used with the GM812 video card, the GM813's unique RP/M monitor allows the creation of cassette or EPROM based programs or files which are upwards compatible with a disk based CP/M system.

GM811 — CPU Board

- 4MHz Z80A CPU
- Four 'Bytewide' Memory Sockets
- Two 8-Bit Input/Output Ports
- 8 Bit Input Port
- RS232 Serial Interface
- 1200 Baud CUTS Cassette Interface



£125 (£143.75 inc. VAT)



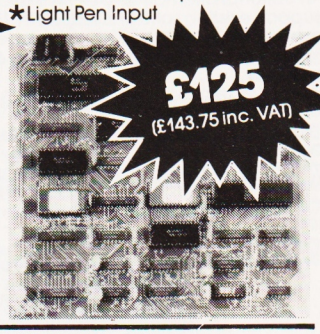
GM812 — IVC Board

- 80x25 Display Format
- On-board Z80A Microprocessor
- Buffered Keyboard Input
- Programmable Character Generator
- 160x75 Pixel Graphics
- Light Pen Input

£145 (£166.75 inc. VAT)

GM 829 — FDC/SASI Board

- Single/Double density operation
- Single/Double sided drive operation
- Up to 4 mixed 3.5", 5.25" and 8" drives
- Industry Standard SASI hard-disk interface



£125 (£143.75 inc. VAT)

Other boards available in the Multiboard range include:

GM802	64K Dynamic RAM Board	**£125** (£143.75 inc. VAT)
GM803	EPROM/ROM Board	**£65** (£74.75 inc. VAT)
MP826	32K Static RAM Board	**£185** (£212.75 inc. VAT)

All MultiBoards are Nasbus* compatible
Ask for latest catalogue for full details.

*Trademark of Nascom Microcomputers Division of Lucas Logic

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COMPUTERS

New from Gemini

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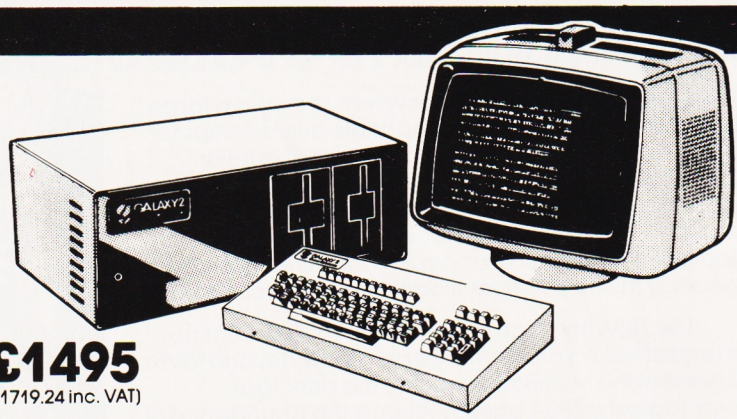
- ★Twin Z80A Processors
- ★CP/M 2.2 Operating System
- ★64K Dynamic RAM
- ★800K Disk Capacity
- ★80x25 Video Display
- ★Serial and parallel printer interfaces
- ★Cassette and light pen interfaces
- ★User definable function keys
- ★Numeric key pad
- ★12" Monitor included



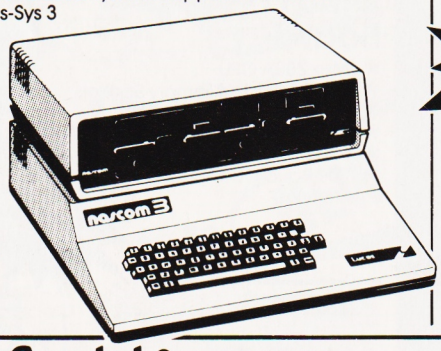
£1495
(£1719.24 inc. VAT)

Total support for Gemini & nascom Products

nascom 3 available from MicroValue

Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied built and tested complete with PSU, Nas-Sys 3 and Nas-Gra.

48K System
£549 (£631.35 inc. VAT)
CP/M 2.2
£100 (£115 inc. VAT)
NASCOM 2 KIT
£225 (£258.75 inc. VAT)
Built & Tested
£285 (£327.75 inc. VAT)



80x25 Video for nascom

£125
(£143.75 inc. VAT)

Nascom owners can now have a professional 80x25 Video display by using the Gemini G812 Intelligent Video Card with on-board Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Software supplied on Gemini system disks. Built and tested.

Nascom 1 Printed Circuit
(inc. parts list)
£25 (£28.75 inc. VAT)

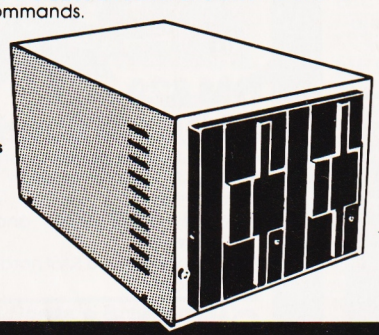
GM802 64K RAM Card **£125** (£143.75 inc. VAT)
GM802K 16K RAM Kit **£80** (£92 inc. VAT)

Disk System for Gemini & nascom

GM825 Disk Drive Unit – The GM825 floppy disk housing is supplied with either one or two 5.25" single sided, double density, 96TPI high capacity Micropolis 1015F5 disk drives. These provide 400K bytes of formatted storage per drive. (Gemini QDSS format). The CP/M2.2 package available supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers.
An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 4, it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single Drive System
GM825-1S
£350 (£402.50 inc. VAT)
Dual Drive System
GM825-2S
£575 (£661.25 inc. VAT)
CP/M2.2 Package
(GM 532 for Gemini)
£90 (£103.50 inc. VAT)

POLYDOS 4
for Nascom
£90 (£103.50 inc. VAT)
GM809 Disk Controller Card
for 8" and 5.25" drives
£125 (£143.75 inc. VAT)
GM829
for 8", 5.25" and Winchester Drives
£145 (£166.75 inc. VAT)

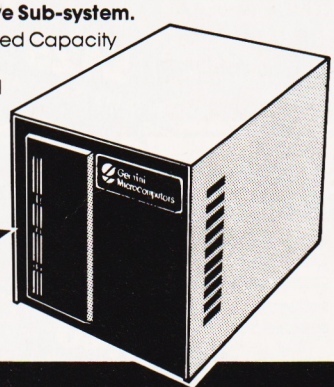


At last – a Winchester Drive for your Gemini / nascom System!

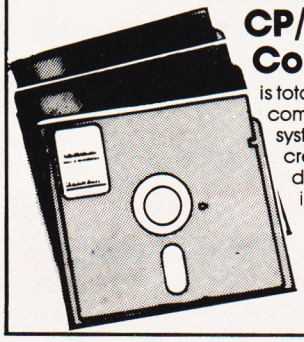
GM835 Winchester Drive Sub-system.

- ★5.4 Megabyte Formatted Capacity
- ★Rodime Drive
- ★Industry Standard SASI interface
- ★Integral Controller and power supply

£1450
(£1667.50 inc VAT)



SOFTWARE



CP/M Software Compas

is totally different from other compiler based Pascal systems, as it allows you to create, edit, run, and debug Pascal programs in a highly interactive manner.

£120
(£138 inc. VAT)

'The Last One' is used in conjunction with Microsoft's MBASIC*. No knowledge of BASIC programming is required since all input is performed using question and answer routines written in plain English.
£330 (£379.50 inc. VAT)
*MBASIC – MicroValue Price if purchased with 'The Last One' – **£178.95 inc.VAT**

VIZ:APL is a high level language system. It can be used to develop small programs faster and large programs in limited memory. The language can be enhanced almost indefinitely and the user's own operators and functions can be built up.
£255 (£293.25 inc. VAT)

Gemini Software:

GEM PEN Text Editor	**£45**	(£51.75 inc. VAT)
GEM ZAP Assembler	**£45**	(£51.75 inc. VAT)
GEM DEBUG Debugging Utility	**£30**	(£34.50 inc. VAT)
WORDSTAR Word Processor	**£215**	(£247.25 inc. VAT)
GEM GRAPHIC Links with MBASIC	**£35**	(£40.25 inc. VAT)

A wide range of software for Nascom also available.
When ordering disks, please specify format.

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A powerful colour computer for under £200.
★ 32K RAM
★ 6809E Microprocessor
★ Extended Microsoft Colour BASIC
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★ Sound through TV 5 octaves, 255 tones
★ Advanced Graphics
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(£199.50 inc. VAT)

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★ Sinclair ZX81 Computer	**£43.43**	(£49.95 inc. VAT)
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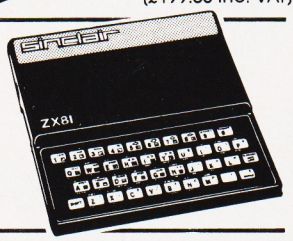
★ 16K ZX RAM PACK	**£26.04**	(£29.95 inc. VAT)
★ ZX81 Learning Lab	**£17.35**	(£19.95 inc. VAT)
★ Software for Sinclair	**from £3.43**	(£3.95 inc. VAT)



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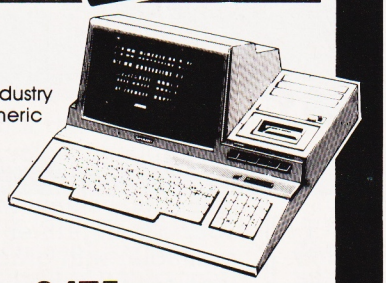
Z80A C.P.U. · 48K RAM · 4K ROM · Industry standard Qwerty keyboard with numeric pad · 9" GREEN C.R.T. · 1200 baud cassette · Music and sound · Real time clock · Enhanced BASIC
· Full editing facilities
· Internal expansion.



FREE SOFTWARE!
Home budget, bank reconciliation, SPACE INVADERS, STAR TREK, SCRAMBLE, bank loan calculator, mortgage calculator + 7 other games.
Educational — Geography, Maths., Spelling + 4 part BASIC tutorial.

£475 (£546.25 inc. VAT)

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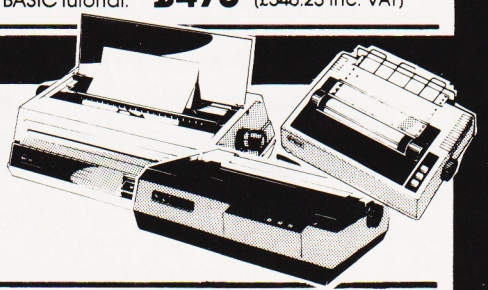


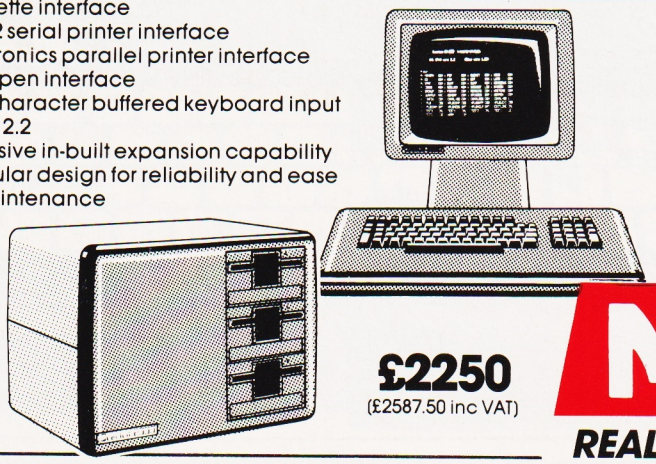
Epson MX80 Type III	**£348**	(£399.95 inc. VAT)
Epson MX80 FT Type III	**£388**	(£445.95 inc. VAT)
Epson MX100 Type III	**£496**	(£569.95 inc. VAT)
NEC 8023A	**£339**	(£389.95 inc. VAT)
SEIKOSHA GP100A	**£215**	(£246.95 inc. VAT)

Daisy Wheel Printer:

Smith-Corona TP-1	**£485**	(£557.75 inc. VAT)

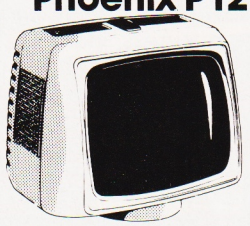
Quantum QM 2000 COMPUTER SYSTEM

* Twin Z80A Microprocessors
* 64K Dynamic RAM
* 2.4 megabytes of formatted disk storage capacity
* 80 × 25 screen format
* 160 × 75 pixel graphics
* Programmable character generator
* Cassette interface
* RS232 serial printer interface
* Centronics parallel printer interface
* Light pen interface
* 128 Character buffered keyboard input
* CP/M 2.2
* Extensive in-built expansion capability
* Modular design for reliability and ease of maintenance



£2250
(£2587.50 inc VAT)

Phoenix P12 Monitor



A high quality data display monitor, ideal for all Nascom and Gemini systems. 20MHz resolution. Available in amber or green phosphor.

£110
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Tel: (02403) 22307

BIRMINGHAM B5
Skytronics MBM, 80 Bristol Street,
Tel: 021-622 6436

BRISTOL
Target Electronics Ltd., 16 Cherry Lane.
Tel: (0272) 421196

COLCHESTER
Emprise Electronics Ltd.,
58 East Street.
Tel: (0206) 865926

EGHAM, SURREY
Electrovalue Ltd.,
28 St. Judes Road, Englefield Green.
Tel: (07843) 3603

IPSWICH
MDW (Electronics),
47/49 Woodbridge Road East.
Tel: (0473) 78295

LONDON W2
Henry's Radio, 404 Edgware Road.
Tel: 01-402 6822

LONDON SW11
OFF Records,
Computer House, 58 Battersea Rise,
Clapham Junction.
Tel: 01-223 7730

MANCHESTER M19
EV Computing, 700 Burnage Lane.
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BUSINESS NEWS

PLOTTING PROGRESS ▲

Grafox have announced the release of some exciting enhancements to their successful Dataplot business graphics package for microcomputers. They have developed an interface to the SuperCalc financial spreadsheet package whereby any part of the SuperCalc matrix can be accessed and plotted by Dataplot. Titles and text in SuperCalc are picked up automatically by the Dataplot package. A standard feature of the powerful Dataplot graphics system is that any screen image can be sent to a Calcomp 81 eight-pen plotter for hard copy output. A 35mm slide and OHP transparency generating package, Graftext, is also available, which drives the Calcomp plotter for hard copy.

Both Dataplot and Graftext are available on micros that support the C/PM and M/PM operating systems. Dataplot drives the Ramtek 6211 VDU for colour screen display (price £2,550) and monochrome VDUs that possess a retrographics board (price £1,800). The prices include the drives for the plotters. If you would like more details, please contact Grafox at 35 St Clement's, Oxford OX4 1AB or 'phone 0865-242597.

THE OPTIMUM MICROS

Optim Computers Limited, previously known as Monotype Communications, has been officially launched. The new company has announced a new business oriented personal computer, the Amigo, which includes a central unit with a full bit mapped display, dual single-sided mini disc drives, and a dot matrix 80 column impact printer (a 132 column printer is also available) with graphics for increased flexibility. The Amigo price starts at £2,046 excluding VAT.

Optim also boasts extreme user friendliness for the Ace multi-function computer system which is available in a range of configurations from a stand-alone micro-processor system comprising a 25 line VDU, 5¼" floppy disc drive and printer, priced at £5,750, including a word processing package, to a multi-terminal, multi-peripheral, hard disc storage business shared resource system. Various enhancements are available.

For further information about any of these products, write to Optim Computers Limited, Lawford House, Harrow Road, London W10, or 'phone 01-969 6768.

IT'S A TERMINAL CASE ▼

A terminal that is convenient enough to tuck into your briefcase has been launched by Technical Designs. Called TransTerm 2 it measures 2" by 7" by 13" and has an 80 character display with a 24 line buffer memory. Programs can be customised to suit individual needs; typical uses are stock movements and industrial control where heating, ventilation and light switching are linked through a computer.

The TransTerm 2 communicates in full duplex RS232 serial asynchronous ASCII, has a 58 key alphanumeric keyboard

with membrane switches and two keyboard modes. Other options include an expanded buffer memory up to 12K capacity, and carrying case with integral acoustic coupler. The terminal is priced at £389. Further details can be obtained from Technical Designs, 2 Albone Way, Biggleswade,, Bedfordshire SG18 8BN or 'phone 0767-312470.

THE FUTURE ASSURED ▶

Future Computers are (according to them) the only company to produce a range of micro-computers which include a local area network communications facility as standard along with the normal serial and RS232C interfaces.

The FX range starts with a powerful stand alone micro-computer and can be added to so that it can become a fully integrated office, with multi-user multi-tasking networks and micro to mainframe communications.

The Future computer has been made 60% faster than other 8088 machines on the market by a combination of special features. It has a faster memory (150 nS), a faster processor, independent refresh control, a separate screen memory which avoids taking up processing time and no wait states on memory access. Machines in the range extend from the low cost terminal, through the intelligent terminal (the FX10), and the stand alone micros to various network processors, with a number of enhancements available. The 16-bit machines are available from £1,500.

Information about the range can be obtained from Future Computers Limited, PO Box 306, Purley, Surrey, or on 01-689 4341.

GOODBYE NELLIE

If you have been watching ***The Computer Programme*** on BBC (and if not, why not?) you will have seen Ian McNaught-Davis showing us the delights of Nellie, a Stantec Zebra computer built in the late 1950s. Nellie started her life as the main computer at the Woolwich Polytechnic until she became obsolete in the mid 1960s.

This piece of historic equipment is now so rare that her owners, Bruce Banks Sails Ltd of Sarisbury, Southampton, have been determined that she should not be scrapped so long as any possibility remained that she could be preserved for posterity. STC, who built Nellie, have now agreed

to take her back for the company archives. The dismantling and removal of her tons of equipment began in November 1982. So Nellie is at last being gracefully laid to rest, and a well-deserved one it is.

NEW DIGITAL COMPUTER

Digital Equipment have announced its lowest priced PDP-11/23 packaged CPU for Original Equipment Manufacturers. Called the PDP-11/23S, the new entry level micro is designed primarily for build-in applications for system designers. The 3½" high, rack-mountable micro is available with either RAM or nonvolatile CMOS memory and an I/O patch panel.

Prices begin at £2,618 and more details can be obtained from Digital Equipment Company Limited, Digital park, PO Box 110, Reading RG2 0TR, or 'phone 0734-868711.

◀ MYRIADS OF STARS

StarGraphics, according to the manufacturers, is the world's first truly low cost, high quality computer graphic slide preparation system. Created specifically for the non-technical operator, the system allows artists, managers, secretaries (or indeed anyone) to design professional high resolution (2,000 line) text, charts and graphic slides quickly and easily in up to 64 colours. Based on a standard Apple II computer, a system costs as little as £2,999, with a processing fee per slide of £10. More information can be obtained from Alan Norman, Marketing Director, Myriad Audio Visual Sales Limited, 10/11 Great Newport Street, London WC2H 7JA or telephone 01-240 1941.

SPECIAL OFFER on Colour Genie

We believe that the new Colour Genie home computer is the best value currently available...

Buy your Colour Genie from us for **£224** fully inclusive of V.A.T. Carriage and Insurance, and any one of the programmes listed below is yours for free. You will also be entitled to purchase 1 game per month for 5 years at 25% off our published prices.

SOFTWARE FOR COLOUR GENIE

SKRAMBLE — £8.95
Fly your ship through an underground complex and win £100. Other prizes include: Colour Genie joysticks, etc. Full details with programme or on written request (S.A.E. please).

EXTERMINATOR — £7.95
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Release full potential of Colour Genie graphics with this very easy to use programme.

GENMON — £12.95
All facilities you need and more in this good quality monitor.

WE INTEND TO PUBLISH AT LEAST ONE NEW ARCADE STYLE GAME FOR THE COLOUR GENIE EACH MONTH!

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STAGE ONE . . . shoot the birds down and avoid missiles.
STAGE TWO . . . run out of 'safe area' and destroy eggs, avoid robots and mines.

REVERSI — £7.95
6 Skill levels make an easy to play but difficult to master game. A callenge to everyone.

FORTRESS OF EVIL — £7.95
A 3-D adventure where objects are manipulated via two word sentences. Your task is to find a Wizard and slay him. But he has his helpers.

DOUBLE AGENT — £12.95
A 3-D real time simulation with hundreds of characters and disguises Your task is to recover plans from an enemy's H.Q. Can be different each time you play, or you can save each game.

BASIC DEBUG — £12.95
If you write BASIC programmes or simply copy them from listings then this is the utility that will help you find those bugs. It enables simpler writing of programmes. Hours of misery avoided.

Please send me the following programme(s):
Basic Debug £12.95 Double Agent £7.95 Exterminator £7.95 Fortress of Evil £7.95 Genmon £12.95
Graphics Master £7.95 Reversi £7.95 Skramble £8.95

Name .....

Address .....

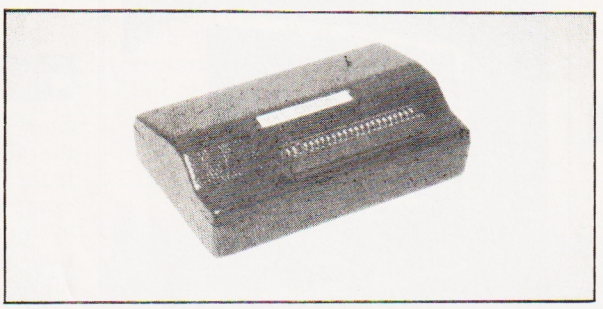
.....

Machine: Colour Genie Genie TRS 80
All programmes listed above are cassette based only, and require 16k memory.
Enclosed Cheque P.O. Access
ALGRAY, FREEPOST, 33 Bradbury Street, Barnsley, South Yorkshire S70 6AQ.

THE CHEAPEST KNOWN RAMPACKS IN THE WORLD

64 K RAMPACK £44.75

16 K RAMPACK £19.75



Fully compatible with ZX81 and all accessories — simply plug straight into user port at rear of computer.

• Fully cased, tested and guaranteed • Gold plated Edge Connector coated for extra long life • Secure no wobble design • Same sleek case for both versions

Price includes VAT and P&P

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INNOVATIVE
TRS 80-GENIE SOFTWARE
from the professionals

smal-LDOS™

LDOS is an advanced and sophisticated disk operating system for the TRS-80 Models I and III, the original Video Genie, the Genie I and Genie II. It comprises some 113K of code. It was over a year in development and cost in excess of ¼ million dollars to write. It contains an advanced Disk Basic Interpreter enhancement, a complete Job Control Language compiler and many other features.

Obviously it is also complex. This is why it is accompanied by some four hundred pages of manual. It is not the best system for beginners.

On the other hand, LDOS contains so many important features that if a person is just starting out with disks he should be aware of them and, if you like, raised in the right habits. Presently available lower cost disk operating systems are all "first generation" and are primitive. Indeed, they tend to train a person in the wrong direction.

For those people who are either just starting with disks or who wish to get an insight into a full scale first quality disk-operating system, smal-LDOS has been produced. It is a sub-set of LDOS and has a manual of 160 pages. It is not an exaggeration to say that it contains most of the advantages of LDOS but still maintains an utter simplicity in use. It is, if you will, a sampler for the main system.

It is also, to the best of our knowledge, the first DOS for these machines that can be upgraded to the larger version at a very reasonable cost. This is because with every smal-LDOS is supplied a coupon to the value of £15. This is redeemable against the purchase of a brand new full LDOS. There are only two stipulations. The first is that the redemption must be through us, not one of our dealers, and secondly the coupon can only be used for the purchase of an LDOS.

Smal-LDOS contains 21 Library Commands, 7 Utilities, 2 Device Drivers or Filters, and Disk Basic as follows:

APPEND	DIR	MEMORY
ATTRIB	DO	RENAME
AUTO	FILTER	RUN
CLOCK	KILL	SET
COPY	LIB	SYSTEM
DATE	LIST	TIME
DEVICE	LOAD	VERIFY
BACKUP	HITAPE	RDUBL
CONV	PDUBL	REPAIR
FORMAT	PR/FLT	KKI/DVR
LBASIC		

For those of you not familiar with the features mentioned above, a brochure is available on either or both smal-LDOS and LDOS. On the other hand you may wish to order immediately, in which case:

smal-LDOS ... ... **£38** + V.A.T.

Plus £1 shipping

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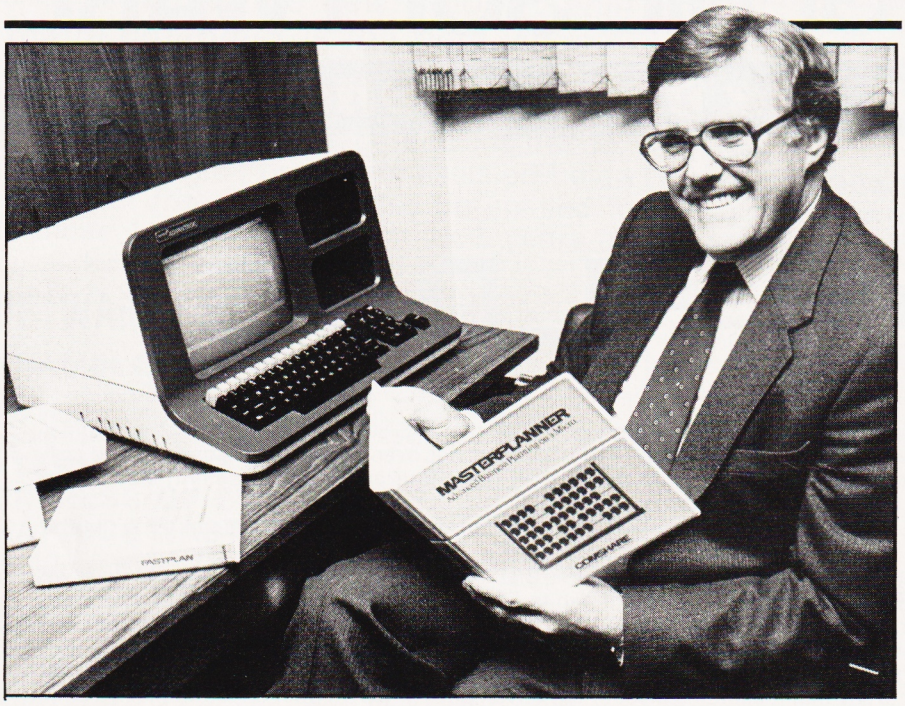
SOFT WARES



APPLE PRESS

Dynatech have produced a number of updates and modifications for their program generator for Apple micros, CORP. In order to make it even easier to use, all CORP packages supplied from October 1st 1982 include a disc of sample programs to illustrate precisely how the generator works and the instruction manual has also been altered.

CORP allows an Apple II user to write his own programs without any previous knowledge of computer programming or technical jargon: all instructions are simply entered in English or any other Western language. Because of its ease of use, business programs, like stock control, invoicing or accountancy packages, can be prepared in three to four hours by a complete novice.

The new CORP package costs £249 and includes master disc, demonstration tutorial, two utility discs, and a diagnostic disc. All items, including the new additions, are also available separately. The demonstration tutorial disc costs £19, sample programs disc £19 and the revised manual £5. All are available directly from Dynatech Microsoftware, Summerfield House, Summerfield Road, Vale, Guernsey.

DEVELOPING A MASTER PLAN ▲

As a step up from Plannercalc (a high quality spreadsheet planning system for eight-bit micros), Comshare have now released the latest versions of Masterplanner, which is available for the Sirius and IBM Personal Computer as well as CP/M machines. Masterplanner has all the facilities of Plannercalc, but also offers the following advanced facilities: CP/M-86 and MS-DOS versions, data transfer to word processing and other systems, extensive formatting of reports, up to 25 stored reports per model, consolidation of models for departments, branches or subsidiaries into a total company model, increased matrix sizes, direct editing of both spreadsheet and logic displays, and even more.

Masterplanner is priced at £245 plus VAT and both it and Plannercalc are available through most good dealers or direct from Comshare on 01-222 5665. Further details can be obtained on the above number or by writing to Comshare, 32/34 Great Peter Street, London SW1P 2DB.

ENLISTING HELP

How else would you want to handle lists except with a filing program called 'List Handler'? The program not only stores and prints lists and labels but prints letters too. Designed for the Apple II, up to 3,000 records can be held so that 24,000 can be kept on-line with multiple disc drives. List Handler will run on one or two drives, work with any DIF format including VisiCalc and DB Master, has unlimited Sort fields and has the ability to read and write text files.

List Handler can stand alone or as a mailmerge interface with 'Word Handler', to make an extremely efficient text editing duo. List Handler can be used with virtually all other Apple word processors. If you want to know more, contact Pete & Pam Computers, New Hall Hey Road, Rossendale, Lancashire BB4 6JG, or 'phone 0706-227011.

IMPROVE YOUR MEMORY

A 16K interactive Pascal language system for any Z-80 based CP/M micro has been introduced by Poly-Data microcenter ApS of Denmark and is available in the UK from Gemini. Called COMPAS, it is compact with the complete system, including compiler, on-screen editor, and run-time routines, contained in a single 16K program leaving more free memory and disc space than any other Pascal system.

COMPAS compiles a large subset of standard Pascal directly into native Z-80 machine code. Due to its very small size, COMPAS allows both source text and object code to be kept within memory at the same time. This means that the compiler is able to process up to 5,000 lines per minute. The compiler can also be used to produce machine code program files. In this case, a 5K run-time package is automatically linked to the object code, and the final program can be run from CP/M simply by typing its name.

All major features of standard Pascal are supported by COMPAS and many extensions are offered to give increased versatility. Priced at £120 plus VAT, more details can be obtained from Poly-Data

microcenter ApS, Strandboulevarden 63, DK-2100 Copenhagen 0, Denmark, or from the UK distributor, Gemini Microcomputers Limited, Oakfield Corner, Sycamore Road, Amersham, Buckinghamshire HP6 5EQ, or 'phone 02403-28321.

OH MY PRECIOUSSSS.

The Hobbit, a full colour adventure simulation based on the Tolkien character, takes pride of place amongst new software for the Sinclair ZX Spectrum and ZX81 personal computers. In The Hobbit, the player assumes the role of Bilbo and undertakes a series of fascinating adventures in which he meets and interacts with all the novel's other leading characters. Depending on his decisions each game will develop differently. Designed to use the full potential of the 48K ZX Spectrum, The Hobbit's special features include original artist designed graphics and a built-in 500 word 'inglish' vocabulary to instruct the computer. The package comes complete with a copy of the novel. The Hobbit is priced at £14.95 including VAT.

Sinclair is also offering four ZX Spectrum adventure games: Inca Curse, Ship of Doom, and Espionage Island (all 48K) and Planet of Death (16K/48K). These programs cost £6.95 each.

Three further ZX Spectrum cassettes are Reversi, or Othello (16K), a modern version of the late nineteenth century board game which offers nine levels of difficulty, Collectors Pack (48K), enabling collectors to hold a maximum of 600 records of up to nine items on one cassette, and Club Record Controller (48K). These cassettes are priced at £7.95, £9.95 and £9.95, respectively.

For the experienced ZX81 owner, the new ZX Toolkit is now available, providing nine new ZX81 functions, at a price of £5.95. Also available for the ZX81 are versions of Reversi and the four adventure games (all ZX81 with 16K RAM pack), a new ZX81 Chess (1K), a Games Pack (1K) with eleven different items, Thro' the Wall/Scramble (16K), and two real time interactive games written in machine code, Super Glooper/Frogs (16K). The prices for these are £6.95, £5.95 each for the four adventure games, £2.95 for the Chess game, £6.00 for the Games Pack, and £4.95 each for Thro' the Wall and Super Glooper.

All 18 cassettes are immediately available by mail order from Sinclair Research, Stanhope Road, Camberley, Surrey.

GETTING IN ON THE ACT

Acting in the best interest of the Sirius 1, ACT have produced four new software packages for this micro, three communications and one graphics package. The communications packages (ASYNCH, 3270 and Remote Batch Emulator) enable the Sirius 1 to communicate with all the most popular mainframes, minis and micros.

The new ACT Sirius Graphics Toolkit enables even those without programming skills to make full use of the Sirius 1's graphics capabilities. The toolkit contains the following: GRAFIX KERNAL (a complete graphics driver); BUSIGRAPH (an interactive demonstration program written in BASIC to create and edit common business graphics); GW BASIC (and extended version of the BASIC interpreter); CHARACTER GRAPHICS (allowing special characters to be designed using a 16 by 10 dot matrix); EFONT (used to create new character sets); KEYGEN (using the 'soft' keyboard to reallocate any or all of the keys to new functions); and MODCON (allows saving, alteration and restoring of both the keyboard and character set files). The toolkit is priced at £195 and the communications packages start at £195. Further information can be obtained from Applied Computer Techniques (Holdings), ACT House, 111 Hagley Road, Edgbaston, Birmingham, West Midlands B16 8LB.

SPELLBOUND

Spellbinder, the word processing package that is claimed to be the easiest to learn and the cheapest, now also acts as a calculator. This new feature allows the user to leave his text, carry out calculations, and then insert the results in the text if required. Also column totals or rows of figures in the text may be checked. Spellbinder has its own language and although it can be learned in 20 minutes it is designed so that the user can write his own programs as he becomes more confident.

The package includes in its price a host of programs aimed at handling most word processing applications, including mailmerge, sorting, forms design and paragraph insertion. Being one of the few systems that will drive a Sanders media printer, the cost of £275 includes assembler files of video and printer drivers, editing programs and manuals. For £200 you can purchase a fully interactive dictionary program which automatically 'proofreads' text and checks spellings against its 20,000 word dictionary. If you want more information on either product, contact Encotel Systems Limited, 7 Imperial Way, Croydon Airport Industrial Estate, Croydon, Surrey CR0 4RR, or 'phone 01-686 9687.

NEXT MONTH

computing today

APRIL ISSUE ON SALE MARCH 11th

MAKING CONNECTIONS

If you have ever been faced with the problems of trying to connect one allegedly 'standard' piece of equipment to another you will know the frustrations that can be caused. Next month we take a long, hard look at the worst offender of all, the RS232 interface. In common use connecting terminals, printers and modems to computers of all shapes and sizes this particular set of interconnections has been so messed about with over the years it often takes longer to sort the wires out once than it will to read the article!

So, if you are considering adding a printer to your machine and it uses a serial interface be prepared for trouble by checking out the facts in next month's issue.

IN INDEXED ORDER

Compiling an index for something is a task of almost Herculean proportions. References, cross references and a thousand and one other bits of information have to be stored, sorted and printed out. So, why not let your micro do it for you?

Owen Bishop, one of ***Computing Today's*** regular contributors and prolific book writer, faced the problem by applying his micro to the task. In our next issue we present the resulting program which can be used for a multitude of purposes from book indexing to cross referencing your office files.

A MICRO DATA BASE

If there is one thing that computers are really good at it is storing and retrieving large amounts of data very quickly.

The trouble is, you need a program to manage the resulting data base, to allow you to alter and ammend it and, most important of all, to find the information you want.

In the first part of a major two-part piece we take a look at the needs of our data base system and start to develop the necessary software. Designed for the TRS-80 in its original form the program should not be difficult to adapt to many other systems as the basic concepts are virtually universal.

VALLEY VARIATIONS

It is now a full twelve months since we published our mammoth adventure program, The Valley. Over the past year we have received numerous hints and tips for the game and in our April issue we have collected the best of these together. So if you are 'into' The Valley and fancy adding some more to it why not take advantage of other people's experiences while you're at it?

A STARRING SYSTEM

From the stable that brought you the NASCOM series of machines and the Gemini Multiboards comes the Galaxy. From the outside this looks like many another Z80-based, 64K, twin disc systems — the surprise is under the bonnet. Quite apart from the fact that the machine is built using traditional architecture; CPU board, RAM board etc it offers COMAL as its main language rather than BASIC. To find out just how much this affects the system's performance you'll need a copy of next month's issue!

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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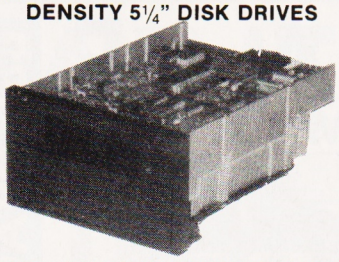

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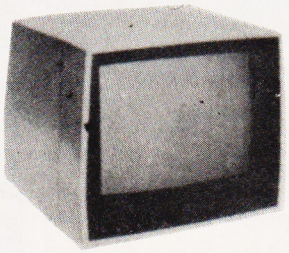

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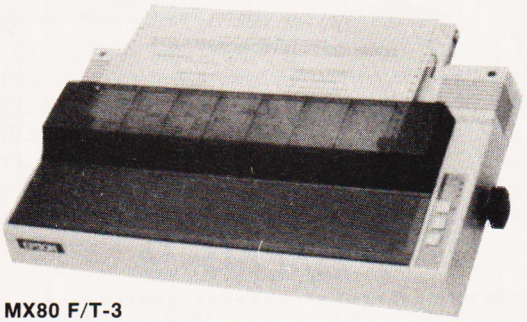

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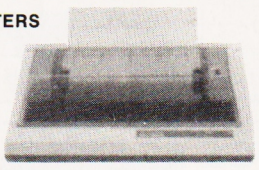

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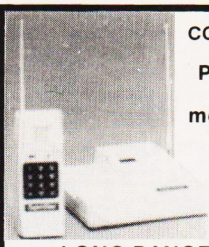

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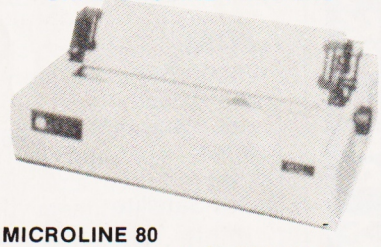

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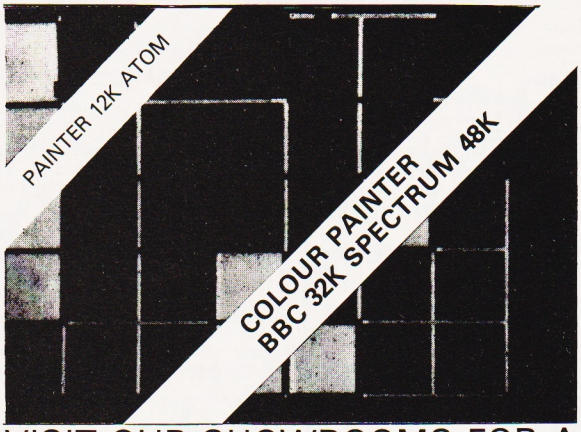

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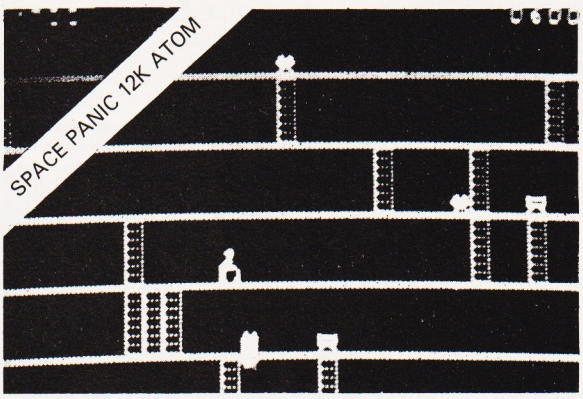

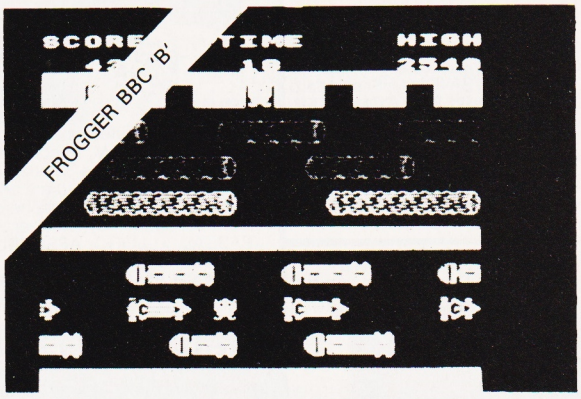

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Simon Goodwin

PAINTING BY NUMBERS

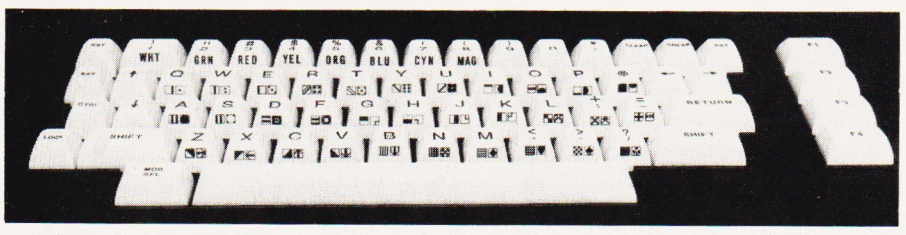
The latest offering from the company that brought you the rival for the TRS-80 is a colour computer for the home market. Will its magic shine through against the strong opposition?

The Colour Genie is the second computer from Hong Kong box-makers EACA. It follows the Video Genie, a computer which closely resembled the TRS-80 (to the extent that the memory-maps and ROMs were almost identical).

The Video Genie (later modified and renamed 'GENIE I' and 'GENIE II') has sold quite well in the UK through the importers Lowe Electronics, an amateur-radio firm turned computer-shack. Since that machine was introduced it has been undercut and outperformed by a wide variety of cheaper computers. The BBC Micro, Sinclair ZX Spectrum, Dragon 32 and other machines have arrived on the UK computer scene and the market for personal computers has shifted from the hobbyist to the home market. EACA have responded to that challenge by producing a new, cheaper machine aimed fair and square at the market-slot occupied by the VIC, Dragon, Atari and BBC computers.

OVERVIEW

The Colour Genie is supplied with a demonstration cassette of programs and leads to connect it to a UK colour or black-and-white TV set, a standard cassette-recorder (motor-control is not provided) and the 240V mains. The computer contains 16K of ROM BASIC and 16K RAM memory, with connections ready for optional joysticks, parallel for serial printers and a Hi-Fi amplifier. It contains a modern graphics chip and a sound-generator similar to the one used in the BBC Micro (need I say more!). A 'bus' connector will eventually allow the computer to control discs, although the appropriate controller is not yet on the market, the original Video Genie Expander is ***not*** compatible with the Colour machine.



The Colour Genie keyboard features the available graphics character set clearly market *a là* VIC-20.

HARDWARE

The Colour Genie is similar in appearance to the Commodore VIC computer, although slightly larger in each dimension. This resemblance is emphasised by the presence of four user-programmable keys on the right-hand side of the keyboard, and the preset graphics legends on the front faces of some keys. It is possible to program the user-keys to generate any sequence of up to seven characters, with an optional automatic Return at the end of the sequence. Graphics are obtained by pressing the 'Mode Select' key and then the appropriate sequence of letters.

Unlike its competitor the Dragon 32, lower-case (small) letters can be entered from the Genie keyboard. A ratchet-action Shift lock button is provided to select capitals only, but this unfortunately acts upon the numeric keys as well, meaning that the user must release 'Shift lock' button is provided to select capitals only, but this unfortunately acts upon the numeric keys as well, meaning that the user must release 'Shift lock' while typing in numbers. A repeat key generates the last key pressed over and over again when it is selected — useful when editing or filling graphics strings — and the clear key can be used to blank the screen and move the cursor to the top left-hand corner of the display.

Four 'arrow' keys are useful for cursor movements in games and a Control key permits graphics and colour selections. The usual Return key marks the end of a line and Break can be used to halt BASIC programs. The original Genie had a hardware reset button on the back panel, useful for stopping machine-code programs or escaping when the computer decides to wait for messages from a non-existent device (such as a printer). The Break key will not work in these cases since the computer will be devoting all its attention to the machine-code.

The Colour Genie reset button has been relocated so that two but- ▶

tons on either side of the keyboard must be pressed simultaneously before the machine will reset. That is a sensible precaution since an accidental reset could halt a program in the middle of a statement, making continuation impossible. The reset is, however, quite forgiving, since it does not delete the program unless the 'R' key is pressed as well as both of the other buttons.

The television or colour monitor display is handled by a specialised Hitachi controller-chip. Curiously, slightly fewer colours are available when using a monitor. The computer performed creditably on both black-and-white or colour televisions, although older sets tended to blur the colours and lines slightly. The picture produced was comparable with that from a ZX Spectrum, only slightly inferior to the colour display of a BBC Micro.

The new Genie has two graphics modes. Text mode allows 16 colours to be displayed at once on a 40 by 24 grid of characters, while the other mode allows medium resolution graphics with 160 by 96 point resolution. Four different colours can be used on the medium resolution screen, and the colour of each point can be set individually.

In text mode the use of colour is more limited, since each character position may contain only one colour on a black background. The pattern of 8 by 8 dots in each character position can be varied by POKEing binary values into reserved memory, allowing 128 user-defined characters similar to those on the BBC Micro or VIC-20. Quite attractive displays can still be produced in text mode, since it has, in effect, twice the resolution of the standard VIC display. Problems come when the graphics will not fit on a character grid — in this case the medium resolution screen is easier to use.

Technical notes about the display controller indicate that it has considerably more power than is used by the standard graphic modes. From these notes it appears possible for an ingenious programmer to modify the instructions given to the chip and hence increase the graphics resolution purely by software, although this would be a fairly complex process.

SOUNDING OFF

Sound on the new Genie is handled by another custom chip, almost identical to the one used in the BBC Micro. This allows three simultaneous notes to be sounded, along wih a 'noise' channel — useful for sound effects such as 'explosion in sandpit' noises. This is a very powerful device, and a connector on the back of the Genie allows the user to connect the computer to a Hi-Fi system if required. BASIC commands allow direct access to the registers in the controller, making a wide variety of effects possible. Unfortunately the only waveform which can be generated is a square-wave, giving all of the sounds a rather 'reedy' tone.

The cassette system works at 1200 baud, which means that a 4K (4000 character) program can be saved or loaded in about 35 seconds. That rate is more than twice as fast as the original Video Genie, but, along with format changes, it unfortunately means that tapes written by its predecessor cannot be read by the Colour computer. A program has been written to allow an old-model Genie to generate tapes for one of the new machines, and it is hoped that a similar program can be produced to run in the Colour Genie, allowing tapes of the old format to be read. The time-constants used by the cassette routines are, most sensibly, stored in RAM so it is possible to POKE new values and modify the speed of the interface accordingly. Rates much higher than 1200 baud could certainly be used for transfers between machines.

The claim that the Colour Genie contains both a parallel and serial interface is a half-truth, hardly surprising in view of the low price of the machine. The serial interface consists of little more than a facility to set and test the voltage levels of two wires from the machine. There is no software support for the interface and no documentation of its facilities. The Colour Genie would support 'software RS232' in which a new machine code program would handle all of the timing needed for serial communication. Existing owners may be interested to know that the interface is wired to port 255 — bit one is used for input and bit two for output.

The parallel port is designed for connection to a dot-matrix printer. The ROM contains routines to communicate with it, using LPRINT and LLIST from BASIC, but an external adaptor is needed to generate signals for a standard Centronics printer.

The processor in the Colour Genie is a Z80, running at 2.2 MHz (30% faster than the TRS-80 or Video Genie). This choice is unusual for a home computer — all the computers listed above with the exception of the ZX Spectrum use the Motorola-style 6502 or 6809 processors, and the Z80 in the Colour Genie belies the similar name and parenthood of Tandy's Color Computer. They are completely different machines.

THE BASIC

Colour Genie BASIC is derived from the original Microsoft BASIC interpreter for the long-gone Altair computer. That interpreter has been modified and used in the TRS-80, NASCOM, and CP/M MBASIC, making it one of the most popular interpreters in existence, with over half a million copies in circulation.

Altair BASIC was an 8K program written in machine code for the 8080 processor. Most computers now running it use the more powerful Z80 processor, which can run 8080 programs (although some of its power is consequently wasted). The Genie ROM occupies 16K, and is written in a mixture of Z80 and 8080 code. The bottom 12K closely resembles the extended cassette BASIC of the TRS-80, although there have been a few changes to hook in an extra 4K of graphics, sound and utility routines.

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EACA have tried hard to preserve compatibility between the new ROM and the 12K BASIC in earlier Genies. They have been fairly successful, although there is one annoying inconsistency. The old read character, print and display routines can all be entered at their original addresses, but there has been one change. The display routine now 'forgets' the character after it has been printed. Consequently any program that displays a character and then acts on its value will no longer work. The original ROM used to retain the character code after a call to 'display', so that many programs must be converted to save and restore the value. That can force major alterations. EACA have even left in some of the old TRS-80 bugs, although they are presumably not important since half a million users have been able to put up with them!

Old and new Genie users might be interested to discover that their computer issues an error message when asked to find VAL("%"), whereas VAL works perfectly for

any other non-numeric character, returning the value zero.

Type SYSTEM and then press the Tab or right-arrow key repeatedly. After about twenty presses strange numbers start to appear on the screen. This is because BASIC has assumed that you will want to load a machine code program soon, and consequently it has moved the Z80 stack into the BASIC input buffer for safe-keeping. The TAB characters overwrite the computer's list of return addresses, so that it gets lost.

There is one new bug in the Colour Genie. When you turn the machine on it displays a MEM SIZE? message, asking the user to reserve memory for machine-code if required. A number is expected here, and strange things happen if you repeatedly type text instead!

Despite these minor idiosyncracies Colour Genie BASIC is a powerful language, allowing four different types of variable: strings (length 0-255 characters); integers (whole numbers between −32768 and 32767); and single or double-precision floating-point numbers. Variables are assumed to be single-precision, accurate to six decimal digits, unless declared otherwise. Double-precision calculations are carried out to an accuracy of 15 decimal places, but they take longer to process than single-precision and occupy more memory.

Integer variables are handled very quickly by the Colour Genie. If calculations can be carried out with whole numbers only (when extracting arrays elements, for example) integer variables can be twice as fast as single-precision.

Variable-names can be any length, although Genie BASIC will not distinguish them beyond their first two characters, so that GENIE and GEISHA would be treated as the same variable. Variable names must not contain imbedded reserved-words, which means that variables such as TO and XLENGTH are not allowed. Programs can be entered in capitals or lower-case letters — the Genie will automatically capitalise text outside strings and comments.

Genie BASIC allows arrays of every variable-type, and there is no limit to the number of dimensions other than the size of available memory. On a 16K Genie there is just under 10K free for BASIC programs after space has been reserved for the display and the interpreter's working storage. This can be increased to about 14K if the MODE SELECT key is held down when the computer is tuned on, since the machine will then assume that medium-resolution graphics are not required and the appropriate memory will be released. To avoid powering-down the machine the memory can be freed from the keyboard by pressing 'R', MODE SELECT and both reset buttons, all at once!

Normally the Colour Genie reserves memory for both the text and graphics displays, using up over 5K of RAM but allowing the user to skip back and forth between displays without losing either picture. The display modes are explained in more detail later in this review.

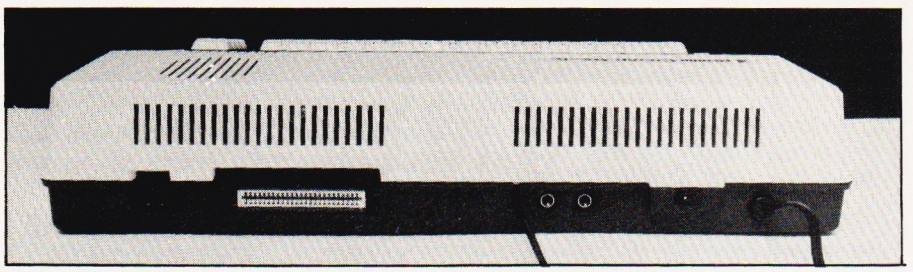
EDIT IT

Colour Genie BASIC allows program lines up to 240 characters long to be entered, and structures such as IF... THEN... ELSE enable the programmer to take full advantage of this facility. There is a line-editor built into the ROM. This allows the programmer to insert or delete text within a line, so that incorrect lines don't have to be retyped from scratch. Unfortunately this is not a proper screen-editor so it is not possible to duplicate or renumber lines using the EDIT command.

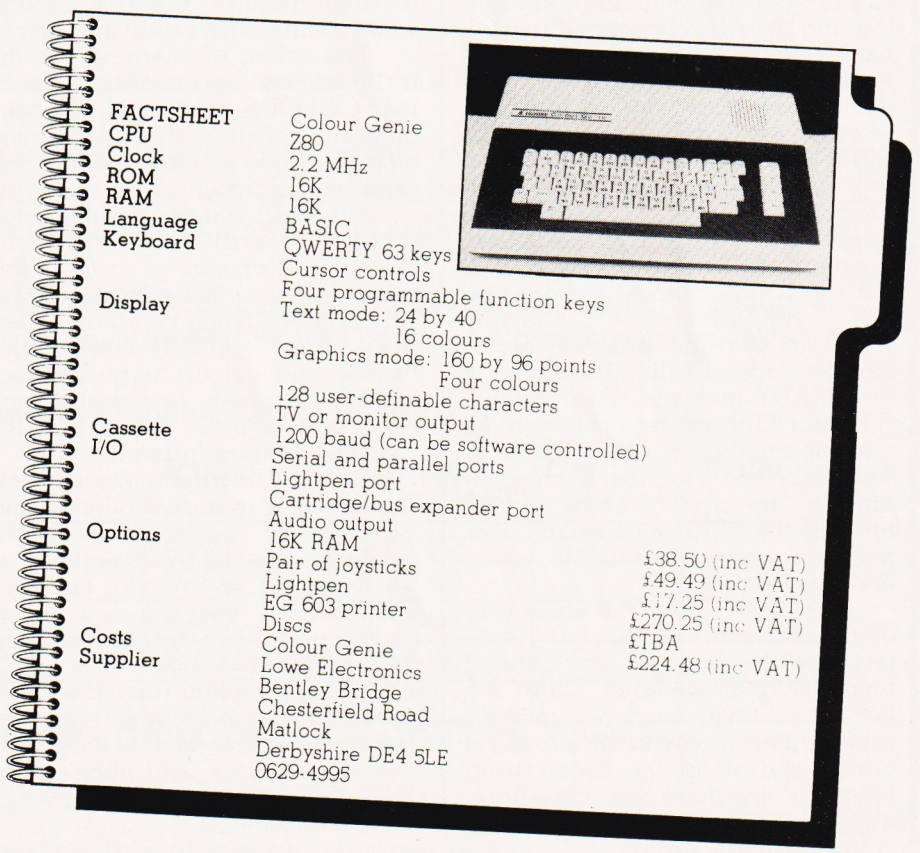
To call up the editor type 'EDIT line number', or 'EDIT .' if the line concerned has just been listed or entered. The '.' is an abbreviation for 'current line', and can be used in LIST commands — 'LIST.−' would list onwards from the current line, for example, and 'LIST 10−.' will list all lines between 10 and the current one. The Genie does not check the syntax of lines when they are entered, but it automatically sets up the current line and calls the editor if a syntax error occurs while a program is running.

Other abbreviations include ? for PRINT, ' (apostrophe) for :REM, and &H used to denote hexadecimal numbers — &H7FFF would be 32767, for example.

Error messages on the new Genie are rather odd — rather than issue error-numbers or English explanations, Genie reports take the

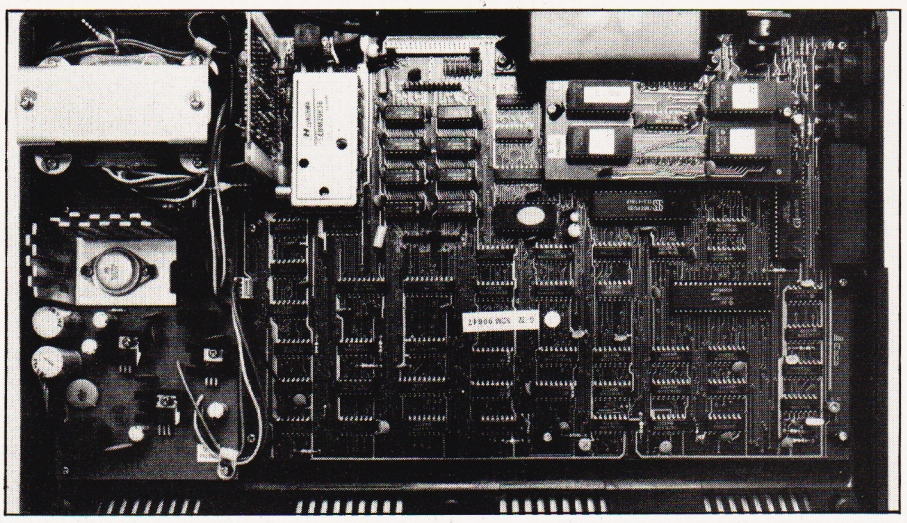


The rear of the machine offers plenty of I/O socketry, see Fig. 1.



FACTSHEET Colour Genie

CPU	Z80	
Clock	2.2 MHz	
ROM	16K	
RAM	16K	
Language	BASIC	
Keyboard	QWERTY 63 keys	
	Cursor controls	
	Four programmable function keys	
Display	Text mode: 24 by 40	
	16 colours	
	Graphics mode: 160 by 96 points	
	Four colours	
	128 user-definable characters	
	TV or monitor output	
Cassette I/O	1200 baud (can be software controlled)	
	Serial and parallel ports	
	Lightpen port	
	Cartridge/bus expander port	
	Audio output	
Options	16K RAM	£38.50 (inc VAT)
	Pair of joysticks	£49.49 (inc VAT)
	Lightpen	£17.25 (inc VAT)
	EG 603 printer	£270.25 (inc VAT)
	Discs	£TBA
Costs	Colour Genie	£224.48 (inc VAT)
Supplier	Lowe Electronics	
	Bentley Bridge	
	Chesterfield Road	
	Matlock	
	Derbyshire DE4 5LE	
	0629-4995	



The positioning of the video circuitry and modulator so close to the mains transformer leaves much to be desired.

form 'SN Error at 1010' or 'NF error'. Two character abbreviations indicate the error which has taken place, so that 'SN' would be short for 'Syntax', 'NF' means 'NEXT without FOR', (contrary to what right-wingers might tell you) and the ingenious '/0 Error' indicates that a program has attempted to divide by zero. The Genie can generate 23 such messages, and it takes a while to learn what they mean. They are an improvement over the 'WHAT?', 'HOW?' and 'SORRY?' of the early micros but it seems strange that EACA could not use some of the extra 4K ROM to include more helpful comments.

Colour Genie BASIC contains a few useful programming utilities including an AUTO command which can be used to generate line numbers in any regular sequence without the need for the programmer to type them in by hand. The RENUM instruction reorganises the line-numbers of the program in memory, evenly numbering the lines and correcting the target numbers of GOTO and GOSUB at the same time. BASIC provides an ON... ERROR... GOTO facility which means that program errors can be trapped without a return to the READY message. Two variable ERL and ERR are set up to contain the line number in which the error took place and a number corresponding to the type of error. Unfortunately the RENUM command does not correct references to ERL, which is rather annoying.

The BASIC is, on the whole very comprehensive, though it lacks facilities to handle user-defined functions or procedures. There is a full set of mathematical functions (unfortunately only accurate to six digits) and all of the usual string functions are there too. One function, VARPTR, allows the programmer to find the addresses of variables in memory. On the TRS-80 this feature has been used for a wide variety of subtle purposes, including high-speed graphics and linkages between BASIC and Z80 machine code. Two statements, CALL and USR, can be used to call up machine code routines previously POKEd into memory. It is possible to reserve memory above BASIC to leave room for such routines.

GRAPHICS

The Colour Genie features a quite extensive set of graphics commands, although it is annoying that their syntax is inconsistent — some of them require brackets around values while others object to them.

The colour of characters in the text mode can be selected by use of the COLOUR command. Sixteen different colours can be displayed on a TV, while a colour monitor will show only eight.

The FGR statement selects the medium-resolution graphics display. Normally it will show whatever was last plotted there, although FCLS can be used to clear that away. BGRD sets the background colour to pink, blue, orange or green, although black can replace pink if the NBGRD statement is used instead.

FCOLOUR selects the ink colour from the four possibilities, and then lines or circles can be drawn on the grid of 160 by 96 points.

It is possible to POKE tables of 'shapes' into reserved memory — each four bits of RAM stores the colour-code for a point (0-3) and a movement direction (up, down, left or right). A painstaking programmer can use this facility to set up complex designs and then move them across the screen with a set of SHAPE commands.

My favourite command is PAINT, which is used to colour in an area of the display. Simply draw a line around the area to be coloured and then PAINT into it. PAINT X, Y,C1,C2 starts from position X,Y, plotting points in colour C2 until a boundary in colour C1 is reached — just like emptying water into a pool.

SOUND

The sound generator in the Colour Genie can be controlled in two ways. A simple PLAY command is useful for music, while more complex effects can be generated by writing directly to the control registers of the chip using the SOUND instruction.

PLAY(CH,OC,NT,VL) will play a single note. VL is the volume (0-15) and CH is the channel number (1-3). At any time there can be a different note sounding on each channel, so that three-note chords can easily be generated. The pitch of the note is selected by NT, where 0 represents a rest and 1,2,3 represent the notes C sharp, D sharp, and so on. OC contains the octave number (1-8).

MANUAL

Much of the information above is not in the provisional manual for the Colour Genie — a hand-bound photocopied document that has accompanied early computers. A pair of printed manuals should be available soon, and a prospective purchaser would do well to ensure that these are available with a 'new' machine. Hopefully EACA have improved their technical writing since they produced the final manuals for the Video Genie system. Those were rather poor, and a set of TRS-80 manuals was needed to get the most from the machine.

Luckily TRS-80 manuals are available cheaply from Tandy shops — they documented many features of the original Genie which EACA did not mention, and may well be useful to users of the Colour Genie — from the point of view of BASIC only the display format has changed. With luck the new EACA manuals will make these purchases unnecessary, but it is useful to know that alternative documentation is available. Of course TRS-80 manuals will not cover features such as the Colour Genie sound and display.

SOFT OPTIONS

The future of the Colour Genie will be decided by the availability of software for the machine. The UK

distributors, Lowe Electronics, have announced that they do not intend to market software for the machine, and this decision could cost them a substantial share of the hobby market. The Colour Genie is a good computer, typical of its class although not oustanding. Colour Genie graphics are inferior to those of the cheaper ZX Spectrum, and the Dragon 32 boasts twice as much memory as the Genie.

Each of those machines also has disadvantages — the inferior keyboard and slow BASIC hamper the ZX Spectrum, while the Dragon 32 lacks lower-case characters. Both rival computers are outclassed by the Genie's sound generator. In practice it is the availability of software that will determine whether or not an informed hobbyist buys the Genie, and in this respect it currently lags behind all of its competitors.

There are a few encouraging signs for the new Genie. Many machines have been sold to people who used to own Video Genie or TRS-80 systems, and these people are well equipped to translate the vast library of TRS-80 programs onto the new computer. In theory this conversion should be quite simple — certainly a small fraction of the effort needed to write new software — and converted programs are already becoming available.

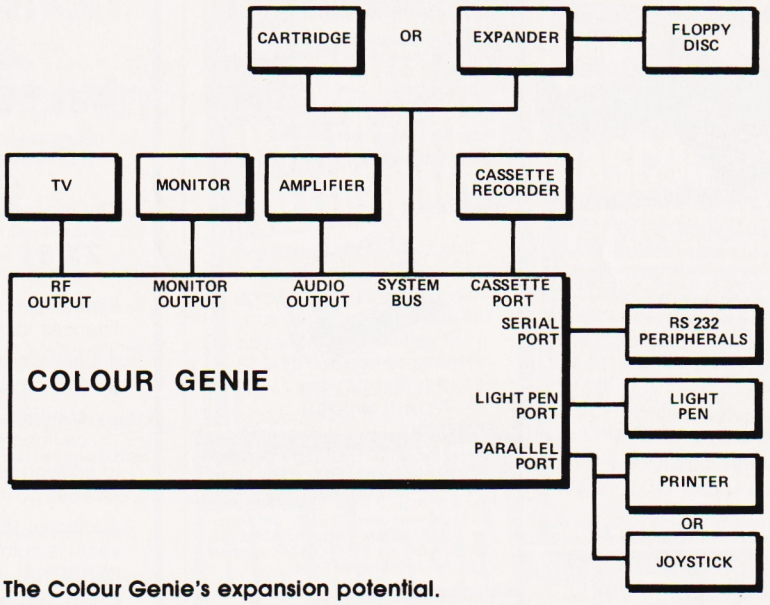


Fig. 1. The Colour Genie's expansion potential.

THANKS

We'd like to thank Marc Leduc for helpful information about the Colour Genie. He is an ex-TRS-80 user who has set out to tackle the software problem by forming a National Colour Genie Users Group. He has converted a number of machine-code programs for the Colour machine, including adventures, an assembler and arcade games. If you've already taken the plunge, he can be contacted on 0602-225165.

Benchmark	Time
BM1	2.6
BM2	11.1
BM3	25.2
BM4	26.0
BM5	29.1
BM6	48.0
BM7	73.2
BM8	10.5/100

Table 1. The Benchmark test results.

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ORIC-1 48K COMPUTER £147.78.

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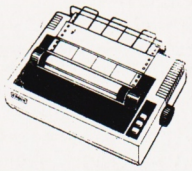

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ELEGANT PROGRAMMING

Getting lists of data into your micro may not be too difficult, but sorting and searching those lists can be an entirely different matter.

It is something of a shame that the twin topic of sorting and searching sounds as though it is a dull, dry and uninteresting subject because, apart from being something every programmer should know a little about, it is also a subject that contains enough surprising and ingenious programming methods to keep any programmer amused! Perhaps the trouble with sorting and searching is that unless you have tried to do either you will underestimate some of the tricky little problems that crop up. This is not to say that humans don't have very much to do with sorting and searching in everyday life. For example, the results of examinations have to be sorted into order, every time you look up a telephone number or a word in a dictionary you are using a search algorithm — even if you don't know which one! By examining the ways that humans carry out sorting and searching you can begin to write programs that do the same things but to make the best use of the special talents and limitations of a computer then you have to think a little harder about what it is you are trying to do.

THINGS TO SORT

The reasons why lists of things are more useful in some kind of order are numerous. In particular, things are easier to find in a sorted list and herein lies the connection between sorting and searching! It is also true that humans are more at home with lists of information in order and tend to worry about a filing system that is chaotic even if there is a way of finding anything that you might want.

The range of things that constitute lists to be sorted is wide. However, from the computing point of view this range can be reduced to considering sorting a list consisting of two pieces of information. The first is the item that you are basing the order of the list on, it could be a number, a letter or even a name. This is often referred to as the 'sort key' or just the 'key'. The second is a number that indicates where the information that constitutes an element of the list is stored. For example, you may want to sort a list of names and addresses into alphabetical order. The ordering of the list is only on the basis of the name part of the name and address record and hence this is the sort key. As you might imagine sorting such a list involves moving a lot of information around. Instead of having to move an entire record consisting of a name and perhaps a very long address each time it is better to leave the records at fixed locations and move 'pointers' to their locations instead. This idea may seem overcomplicated, especially for BASIC, but in fact it can be implemented very easily. If you assume that the name and address, or any other information to be sorted, is stored as elements of an array (or even a number of arrays) then you can set up another array that holds a list of pointers to the elements of the first array. So if the names and addresses are stored in N$ and the pointers in N the location of the first name and address record is in N(1) and N$(N(1)) is the record itself. In the same way N$(N(2)) is the second record, N$(N(3)) is the third and so on. Sorting the list of names and addresses can obviously be done by moving only the elements of the array N and leaving all the elements of N$ exactly where they were. The saving in time gained by using the second array N to hold the order of N$ far outweighs the cost of the extra memory needed for N.

HOW WELL DOES IT SORT?

If you have a program that sorts a list into order then obviously it is important that it does its job fast. There are some sorting algorithms that work well enough with small amounts of data but the time that they take increases rapidly if you increase the amount of data to be sorted. It is important to know how well a sorting method works but how do you measure this? The time that most sorting methods takes depends on the actual set of data you give it to sort as well as how much of it there is. For example, if the list happens already to be in order then nearly all sorting methods will notice this and stop after doing very little work. A similar speed increase is the case in less extreme examples, in other words the more the list is already in order the faster a sorting method works.

COMPARING THE SORTS

An obvious measure of how good a sorting method is, is how fast on average it will sort a list of a particular size. There will be lists that are sorted faster and there will be lists that take longer. In fact there will be lists that take a lot longer than the average time — for example, a list that is ordered in entirely the reverse order to that desired, such lists are often called 'pathalogical'. When comparing sorting methods there are two things to be taken into account — the average time to sort a list and the longest time to sort a list.

For instance, if you find a sorting method that is fast on average but incredibly slow on a pathalogical list then make sure all your lists are well behaved or be prepared for a long wait every now and again! Obviously the time that an ideal sorting method takes should increase as slowly as possible as the length of the list increases, should be fast on average and not much worse for a pathalogical list. Now that we know

what we want it has to be admitted that most sorting methods are far from ideal!

SOME SIMPLE SORTING METHODS

If you were given a pile of marked exam papers and were asked to put them in order you might proceed as follows:

1) scan through all the papers and find the one with the highest mark;
2) place this paper at the front of the pile.
This paper is now 'sorted' and takes no part in any further sorting;
3) repeat (1) and (2) with the 'unsorted' remainder of the pile, putting the highest one in front of the remainder, until all the papers are sorted.

This is known as a 'selection sort' because it is the repeated application of selecting the highest mark from the remaining papers that is used to sort the pile. In BASIC this is:

```
10 LET N=10
20 DIM L(N)
30 GOSUB 1000
40 GOSUB 2000
50 GOSUB 3000
60 STOP

1000 FOR I=1 TO N
1010 LET L(I)=RND
1020 NEXT I
1030 RETURN

2000 FOR I=1 TO N-1
2010 LET M=I
2020 FOR J=I+1 TO N
2030 IF L(M)<L(J) THEN LET M=J
2040 NEXT J
2050 LET T=L(I)
2060 LET L(I)=L(M)
2070 LET L(M)=T
2080 NEXT I
2090 RETURN

3000 FOR I=1 TO N
3010 PRINT L(I)
3020 NEXT I
3030 RETURN
```

Subroutine 1000 constructs a list of random numbers to be sorted and subroutine 3000 prints the list. Both of these subroutines will be used in the following examples without being given again. Subroutine 2000 is the actual sort part of the program. It works in much the same way as the 'human' method except it uses a single array rather than a 'pile' of papers. Lines 2010-2040 find the largest value in the array starting from L(I) and ending with L(10). Lines 2050-2070 carry out a 'swap' between L(I) and the largest element. Finding the largest value and swapping it is repeated until the array is sorted by the FOR loop starting at line 2000.

The selection sort is not a fast method. Just by looking at the way the two FOR loops are nested you should be able to see that if L has N elements the complete sort will take roughly N*N/2 comparisons and 3*N swaps. This figure, however, is not affected at all by any order already present in the list so the selection sort is equally bad for all cases!

Another sorting method based on the way a human might do it is the 'insertion' sort. If you were given a hand of cards to arrange in order you might proceed something like:

a) Place the first two cards in their correct order;
b) Then place the third card correctly within the first two;
c) Then place the fourth card in its correct place within the first three and continue like this until all the cards have been sorted.

This idea is easy to convert into BASIC by using two arrays. The first holds the items to be sorted and the second is used to place the items one at a time into order.

```
10 LET N=10
20 DIM L(1N)
30 DIM A(N)
40 GOSUB 1000
50 GOSUB 2000
60 GOSUB 3000
70 STOP

2000 LET A(1)=L(1)
2010 FOR I=2 TO N
2020 LET J=1
2030 IF L(I)<=A(J) THEN GOTO 2090
2040 FOR K=I-1 TO J STEP -1
2050 LET A(K+1)=A(K)
2060 NEXT K
2070 LET A(J)=L(I)
2080 GOTO 2130
2090 LET J=J+1
2100 IF J<=I-1 THEN GOTO 2030
2120 LET A(J+1)=L(I)
2130 NEXT I
2140 RETURN
```

and change line 3010 to:

```
3010 PRINT L(I),A(I)
```

The sort is once again carried out by subroutine 2000. Line 2000 takes the first item in the list L and places it in the array that the sorted list will be stored in (ie A). The FOR loop starting at 2010 is responsible for inserting each of the items from L into A. Lines 2020-2120 are responsible for actually carrying out the swap. The new item is compared with the items already sorted in the array A by line 2030. When the correct position for the new item is found then lines 2040-2060 make space for it by moving all the elements that are smaller than it up the array by one place. Then the new item is inserted by line 2070. If the new item is smaller than any already in the array A it is just appended to the end by line 2120 without having to make any space.

This procedure looks as though it will be slower than a selection sort because of all the moving of already sorted items to make room for new items. However, things are not what they seem. The number of comparisons needed to sort N items is only N*N/4 which is better than selection sort. The number of moves of items is also N*N/4 which is better than the 3N swaps of selection sort except when N is tiny.

OTHER SORTS

The next sorting method, the 'bubble sort', is perhaps a little too well known. This is really the first method that is not based on the way a human would sort things but tries to make use of the speed with which a computer can do simple things. The basic bubble sort algorithm is easy to understand. All you have to do is make a 'scan' through the array comparing items that are 'next door' to each other. If they are in the correct order then nothing is done. If they are in the wrong order then they are swapped. This scan is repeated until the list is fully sorted and there are no swaps made on a scan. The BASIC for this is:

```
10 LET N=10
20 DIM L(N)
30 GOSUB 1000
40 GOSUB 2000
50 GOSUB 3000
60 STOP

2000 LET F=0
2010 GOSUB 2500
2020 IF F=0 THEN RETURN
2030 GOTO 2000

2500 FOR I=1 TO N-1
2510 IF L(I)>L(I+1) THEN GOTO 2560
2520 LET T=L(I)
2530 LET L(I)=L(I+1)
2540 LET L(I+1)=T
2550 LET F=1
2560 NEXT I
2570 RETURN
```

The structure of this program is very simple to understand. Subroutine 2000 first sets a flag F to zero and calls subroutine 2500 which performs a scan and sets the flag F to 1 if a swap occurs. Line 2020 repeats the scan until the F is zero indicating that the array has been completely sorted. Subroutine 2500 performs the scan using a FOR loop and compares L(I) with L(I+1). The swap is carried out by lines 2520-2540 and the flag is set in 2550.

It is a fact that the bubble sort is so easy to understand and quick ▶

to program because it is far from a good method of sorting. You need about N*N/2 comparisons and 3*N*N/4 swaps to sort a list of N items and this is worse than an insertion sort! The interesting thing about the bubble sort is that you can find lists that it works very quickly on — for example, a list that has only a few well separated pairs of items in the wrong order will be sorted in one scan — but there are also lists that it does very badly on — for example, a list in reverse order. In conclusion, the bubble sort is slow and very sensitive to the initial order of the list.

There is an improvement to the simple bubble sort that makes it very good indeed. The main trouble with the bubble sort comes from the fact that items move by only one place at a time. If an item is at the bottom of the list and it should be at the top then it will take N scans to move it to its correct place. If we extend the bubble method to comparing and swapping items that are further apart than one then we might improve the speed with which items reach their final resting place. If the distance between items compared and possibly swapped is D we call the resulting sort a D-sort. In other words, the bubble sort can also be called a 1-sort. The only complication is that a list can be sorted as far as a 4-sort, say, is concerned but still not sorted as far as a 1-sort is concerned. In practice we employ a sequence of sorts with decreasing distance between the items compared until a 1-sort finally gives the fully sorted array. This method is often called a Shell sort after the person who first invented it. A Shell sort in BASIC is not much more difficult than a bubble sort:

```
10 LET N=10
20 DIM L(N)
30 GOSUB 1000
40 GOSUB 2000
50 GOSUB 3000
60 STOP

2000 LET D=8
2010 IF D<1 THEN RETURN
2020 LET F=0
2030 GOSUB 2500
2040 IF F=1 THEN GOTO 2020
2050 LET D=D/2
2060 GOTO 2010

2500 FOR I=1 TO N-D
2510 IF L(I)>L(I+D) THEN GOTO 2560
2520 LET T=L(I)
2530 LET L(I)=L(I+D)
2540 LET L(I+D)=T
2550 LET F=1
2560 NEXT I
2570 RETURN
```

The way that this program works can be understood by comparing it with the bubble sort given earlier. The distance between items compared is stored in D and starts out at 8. After each scan at a particular D returns without making any swaps, the value of D is halved and a new series of scans is initiated. This continues until a 1-sort returns without making any swaps. Thus the sequence of sorts is 8-sort, 4-sort, 2-sort, 1-sort.

It is difficult to say how good the Shell sort is on average as it depends on the initial value given to D but the main point is that it is a good sorting method to use unless you are going to be sorting very large lists of data.

This examination of sorting methods could continue without end. There are better methods of sorting data than the Shell sort but these would need an article each to explain.

RUNNING OUT OF MEMORY

Each of the sorting methods described above only work if all the data can be stored in memory at once. What do you do if you have a very large disc file to sort? The answer is surprisingly simple and leads to a sorting method all on its own.

Let's suppose that you have a list of 100 records to sort and only enough memory to hold 50 of them at a time. All you have to do is to split the list into two parts of 50 records each and sort them independently of one another in memory. To make a single fully sorted list of 100 records all you have to do is to merge the two files in the following way:

1) read item1 from file1 and item2 from file2;
2) write the largest of item1 and item2 to output file;
3) read a new item from correct file to replace item written out;
4) repeat (2) and (3) until both files are empty.

As an example, consider merging the two lists 9,5,3,1 and 8,7,6,2. The first two items are 9 and 8, and as 9 is greater than 8, 9 is written out. As the item from list one was written out, the next pair of items is 5 and 8 and, as 8 is greater than 5, 8 is written out and the next item is read from list two. If you carry on you will eventually get a fully sorted list of eight items.

In general, to sort a list too big to be held in memory simply split it up into a number of smaller files that will fit into memory and then sort these. To obtain the final sorted list all you have to do is perform a merge on all the smaller sorted files, reading one item from each, writing out the largest and replacing it by a new item.

You can use merging as a sorting method by dividing up the list of items into files consisting of one item! These one element lists are obviously sorted and can be combined together in pairs using merging. The resulting two element files can then be merged in pairs to yield sorted files of four items and so on.

SEARCHING

The time has come to consider our other topic this month — searching. In the same way that the data item that a list is ordered on is called the 'sort key', the data item that is used to detect a match during a search is called a 'search key'. For example, if you have a list of names and addresses and you are searching for someone with a particular name then the name is the search key.

If the list that you are searching isn't sorted then there is really no alternative to starting at the top and comparing the search key with every item. If the list has N elements then on average this process will take N/2 comparisons to come up with an answer. However, if the list is ordered then there is a much better method of searching it called binary search. If we assume that the list is in ascending order, with the largest value at the bottom of the list, then binary search works like this:

1) starting at the middle of the list,
   if the middle item is bigger than the search key then the item we are looking for must be in the upper half of the list;
   if the middle item is smaller then the item we are looking for is in the lower half of the list.
2) repeat (1) on the half of the list that the data item lies in until it is found.

For example, if the list is 1,3,5,7,8,9,12 and we are looking for 3, the search begins at the middle of the list ie the fourth item. This is 7 which is bigger than 3. This tells us that what we are looking for is in the first half of the list. Continuing the search at the middle of the first half we examine the second item or 3 which is of course what we are looking for. A binary search takes on average only logN comparisons which is considerably faster than N for the direct search.

MAKING A HASH OF IT?

If you have a sorted list to search then you cannot do much better than use a binary search. The question is what do you do with a list that is being built up and searched continuously. You could spend a long time sorting it before every search. The answer to these problems is that if you can afford more storage than strictly needed for the list you can use a technique known as 'hash coding'. (Notice that this is another example of the general principle of trading memory for speed.) Hash coding works like this:

1) when an item is added to the list its search key is used to calculate the place in the list where it should be stored. The equation used to calculate this is known as the 'hash function'.
2) when you need to find an item the hash function is again applied to the sort key and this produces the location where the record can be found without any searching for it at all!

For example, consider a list of names and addresses that have to be searched for a particular name. A possible hash function is to convert each of the letters of the name to its ASCII code and add them up to produce a single number. if we assume that there are 10 letters in a name the result of this hash function will lie in the range 0 to 2560. This could be used as the index to any array that was used to store the information. So when a new name and address arrives we apply the hash function to the name to get a number that is used as an index to the element of the array that the name and address will be stored in. To find the address corresponding to a name we once again apply the hash function to produce a number that is the index of the element where the name and address is stored.

This use of a hash function sounds rather like magic. After all it allows you to store and retrieve data without any searching! The difficulty with this method is selecting a good hash function. In practice, any hash function will return the same suggested location for a number of values of the search key. In the previous example, where the hash function consisted of converting the letters to ASCII and adding them together, it should be obvious that the name 'SMITH' and the (unlikely but possible) name 'MITHS' will both give the same result. If this happens where should the records be stored? The usual solution to this 'collision' problem, as it is known, is to store the first record in the location given by the hash function but store all subsequent entries in the first free location following its position as allocated by the hash function. To find records when there is the possibility of collision we have to modify the hash technique to include a search. The hash function is applied to the key. If this gives the location of the required record then fine, if not you have to examine the subsequent locations in the list until you find what you are looking for.

The subject of hash coding and choosing a hash function is too big to go into in any more detail here. There are plenty of reference books that cover the subject in great detail however! If you have followed the basic idea you should be able to see why it is worth looking hash coding up.

Next month we reach the final part of this series and take a look at the interesting topic of recursion and try to take an overview of some of the things that have featured in earlier parts.

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PORTABLE POWER

Already justifiably well respected for their printers Epson have attempted to break into the portable micro market with their new HX-20 system. The Editor's been carrying one around for a few weeks and here's his report.

They say that the world is shrinking, that we are running out of room to move and live. Well, if today's generation of small computers is anything to go by the micro manufacturers are preparing for the worst! Recently launched into the European market as the HX-20 is a new portable micro system from those printer people Epson. The system had been around in Japan for a while, as the HC-20 before hitting the US market so at least I was in some way prepared for the little thing!

I described it as a system because that's what it is; you get a mass storage unit (one microcassette), a hard copy device (a 24-column microprinter) and a display device (a four line, 20 character LCD panel). The question is, what can you use it for? Epson's attitude to the system seems strange, to say the least as they have appointed a national dealer, Norbain, to handle the product rather than doing it themselves. The current advertising campaign seems to be aimed at selling the HX-20 into a wide range of markets from the businessman who wants to take some computing power home to the travelling salesman who could use a portable data capture device. The specification is certainly comprehensive and yet...

WHAT YOU GET

The HX-20 arrives in a box more expected of a piece of Hi-Fi than a computer, it's even got a nice little carrying handle so you can carry your new portable micro home! Once unpacked a small brown attache case is exposed to the world and this contains the micro and the power supply. However, you cannot fit the extra memory pack or the manuals in so, although you can carry the computer you might be a bit stuck without the reference works.

The first striking thing, apart from the sheer lack of size, is the clean and neat look. Styled in silver with black keys, 68 of them, and fitted with its cassette and printer the HX-20 somehow looks 'right'. Styling apart, looks aren't everything, the vital controls, interface sockets etc are all well sited and the whole thing falls neatly to hand. Turning on the system causes a discreet bleeping from the integral speaker and then the LCD display lights up with the message as shown in Fig. 1. This menu initially offers just the choice of the two built-in programs, the monitor or BASIC, but as you add programs of your own these can be SAVEd using the TITLE command under BASIC and will, therefore, appear on the menu list.

Normal operation of the machine, ie firing it up in BASIC, reveals an interesting concept as regards the storage of programs. If you type STAT ALL the HX-20 will reveal the current status of its internal memory areas and you find that you can, depending on there being enough RAM, have up to five totally separate programs resident in the machine at any one time. To access any of these areas one uses the LOGIN command. As you enter your programs the HX-20 allocates memory for the storage of the BASIC to that particular area, this means that no memory is wasted as the system only sets aside variable storage space when it is required by the current running program.

KEYING TO SCREEN

The actual usability of the HX-20, or any other machine come to that, is governed by the interface between it and the user, ie the keyboard and the display. The keyboard is good, although rather too soft for my own liking, with a standard QWERTY ▶

layout. Each key is rather bigger than usual with virtually no gap between each — rather like the original Tangerine keyboards. As well as the basic alphanumeric set a number of special function keys are provided, to wit three system keys, five user programmable keys, four editing keys, cursor controls and a graphics key.

No numeric keypad is provided but by pressing the NUM key certain alpha keys are re-allocated to numeric funtions so fast figure input is quite easy. A total of 34 predefined graphics characters are provided and although they are not legended on the keytops they can be directly accessed through the GRPH key, see Fig. 2. All the ASCII codes between 224 and 255 can be user defined and accessed either from the keyboard or by their CHR$ code.

The LCD display consists of a physical four line, 20 character window on a virtual screen which the user defines. The size of this virtual screen is limited to a practical maximum of 37 lines of 40 characters but there is nothing to stop you using a screen format of, say, 20 lines of 80 characters for portable word processing. Each element of the LCD array can be addressed in the machine's graphics mode and the text and graphics screens can be overlaid making the labelling of graphs a simple matter. The resolution of the LCD display is 120 dots across by 32 down, a total of 1,280 points. The contents of the screen can be copied directly onto the printer simply by pressing the COPY key.

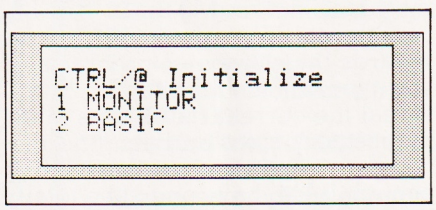


Fig. 1. The initial screen display offers the choice of entering BASIC or the monitor. If user programs were stored as named files in the machine they would also appear on the list.

Epson have obviously tried to prepare the HX-20 for as many markets as possible, being battery powered they only have to change the mains charger to suit the local voltage, and they have included no less than eight international alphabets, selectable by a set of DIP switches housed under the bottom cover.

GETTING BASIC

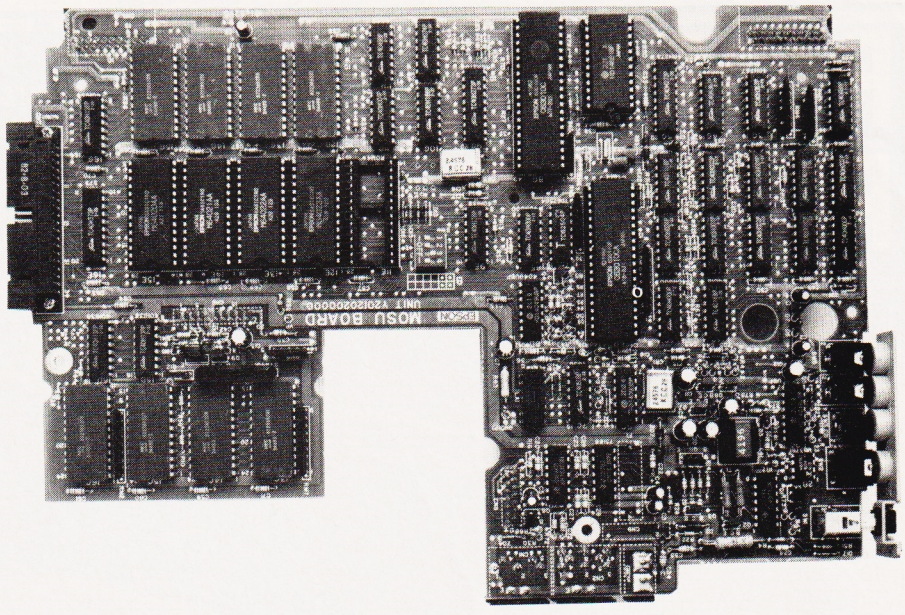
Regardless of any other feature of the system the version of BASIC that Epson have shoehorned into the HX-20 must surely be its strongest selling point. OK, so it's not BBC BASIC but it has a very impressive repertoire of commands and functions at its disposal. The almost obligatory Microsoft set is there in full with added extras such as IF... THEN...ELSE, AUTO and RENUM, definable variable types (integer, single and double precision and string), error trapping and SWAP, a command to exchange two variables which I haven't seen since the Zenith Z89.

As well as supporting 'normal' programming operations a suite of commands has been implemented to make the most of the four line LCD display. These include dot plotting, line drawing and point testing. The LCD display may be copied directly onto the printer by either pressing the special COPY key or by inserting the COPY statement in a BASIC program.

Full formatting using the USING is provided and control of the external printer's line length can also be adjusted by using the WIDTH command. Other examples of the care taken in providing full facilities to make use of the rest of the hardware include a complete set of file handling commands. These even include functions to determine the length of a given file, to wind the tape to a predetermined position and to transfer files from one HX-20 to another over the serial interface.

Strangely there appears to be no BASIC keyword for the lightpen/barcode reader input, an omission that would appear to mean that the device must be handled under machine code or through an extra special purpose ROM which, presumably would occupy the spare slot. Also noticeable by its absence is a method to remove a TITLEd program from the menu without completely re-initialising the whole machine. Now, while the idea of being able to partition off the memory into discrete areas that can be directly accessed from the initial menu is really quite sensible there ought, surely, to be some internal housekeeping routine to look after it?

My overall impression of the BASIC interpreter is that Epson have taken great trouble to provide all the facilities one is likely to need in a portable machine without cluttering up the limited space with commands and functions that are not essential. The limited range of graphics commands, for example, doesn't matter because the display is not really capable of anything more sophisticated! If, and when, the full screen adaptor arrives then presumably a further extension to the BASIC could be added quite simply.



The main PCB is excellently constructed. All the major devices are socketed and all the components are of top quality. The odd notch is the recess for the NiCad battery.

GOING BY THE BOOK

If one assumes that the main area of application for the HX-20 is as a portable terminal running a dedicated piece of software; part of a stock control system or a remote order processor for example, then one doesn't really need to know how to program it. However, the machine is currently being heavily promoted in both the specialist and consumer Press, a course of action that suggests that Epson would like to break

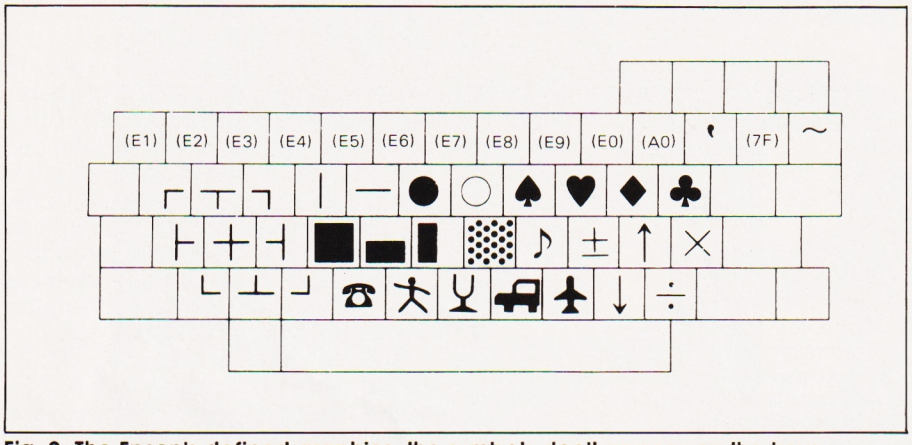


Fig. 2. The Epson's defined graphics, the symbols don't appear on the keys.

it into the home market as well as the business sector. In this case the documentation supplied is sadly lacking. What is provided is excellent; the hardware book is very thorough and the BASIC reference manual is also well produced but both assume that you know which end is up. For a first time user neither of these is likely to be of any use whatsoever, at least as far as programming goes. They will certainly tell you how to turn it on and get a program loaded off tape but this is hardly a games machine so very little commercial software exists.

Grundy made the same error with the initial manual for the New-Brain and, thankfully, recognised their mistake and produced an elementary guide plus cassette for the first timer. Epson need to seriously consider this course of action too. On the plus side, however, is the fact that the manuals appear both technically and grammatically accurate which only goes to show that if the Japanese want to write in English they can! If you are already familiar with BASIC of the Microsoft kind and can cope with the dry style of a reference volume then you will have no trouble at all.

Totally missing from the documentation package is any reference to the microprocessor used and, therefore, any indication as to what machine code you should input to the monitor! The facilities of the monitor program itself are fairly well covered but unless you happen to know that the brute uses two 6301 processors and can obtain the necessary information as to the machine code these run you are rather stuck. So, another volume is required here and, hopefully, it won't take too long to produce as the facility is certainly a useful one.

THE INS AND OUTS

For a micro of its physical size the HX-20 is fairly well equipped with interfaces. Apart from the system expansion, which I have dealt with elsewhere, Epson provide a simple serial interface, suitable for linking to an Epson MX series printer, a full RS232 serial interface, used for modem and inter computer communications, a barcode reader interface and provision for an external audio cassette recorder.

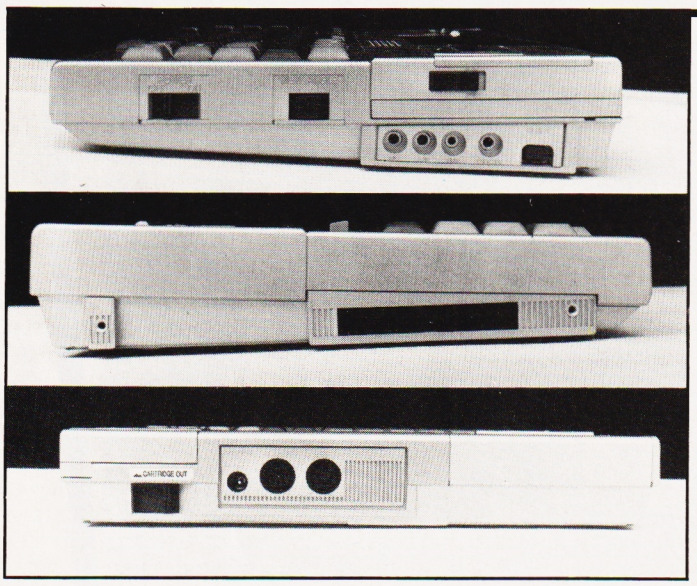
The Hardware manual details all the connections on the various sockets in great depth, it even provides timing diagrams in some instances, but for those who are not DIY oriented Epson manufacture a range of leads for various applications. Control of the main RS232 interface is undertaken from BASIC with the OPEN command and the various options such as PRINT and INPUT apply as in Microsoft BASIC. You can even swap programs directly with another HX-20 by linking the two with the appropriate cable and simply LISTing or LOADing to the communications port.

The facility to replace the microcassette with a ROM pack means that the HX-20 could be without any form of mass storage so Epson have provided an interface to enable a normal audio cassette recorder to be used. Full motor control is provided, as long as your cassette has a remote facility, and apart from specifying the cassette as being CAS1 operation is as normal. The protocols used by the two tape mechanisms are standard so information stored on one can be copied quite happily onto the other.

Quite how the barcode reader will operate I'm not exactly sure but as there don't appear to be any directly accessible BASIC commands one can only presume that either a special ROM cartridge will be needed or that the spare ROM socket inside can be used to provide extra functions that the manual doesn't yet cover. The latter option would seem to be the more likely as the sort of user who would be reading barcodes would probably also like to store the information and as you have the microcassette to fit a cartridge you would lose this facility.

SYSTEM EXPANSION

I always wonder why manufacturers of portable systems always announce vast numbers of peripherals and other expanion bits and pieces which, when added to their brainchild, promptly make it totally unportable! Well, needless to say, Epson have followed suit and are offering two memory expansion modules; 16K RAM and 16K RAM plus 16K ROM as well as promising discs and a video adaptor by the middle of the year. Of these I was only able to try out the memory expander and suffice it to say that it works — what else can one say about memory? The expansion unit fits neatly along the left-hand side of the HX-20 and plugs into the normally covered connector there. To prevent a touch of the Sinclairs they have thoughtfully provided a pair of metal brackets which, when screwed to the case and the expan- ▶



Top: From left to right we have the on/off switch, contrast, external cassette connectors and the system reset button.

Middle: The expansion socket, the two holes are for the support bracket.

Bottom: Power and the two serial interfaces are located at the rear. The knob on the left ejects the micro-cassette module.

sion box, prevent the two coming apart in mid calculation. However, one slight problem. The person who designed the plastic attache case that you carry the HX-20 around in and the man who decided that an add-on memory unit would be nice obviously work at opposite ends of the Epson R&D facility. You can't fit an expanded HX-20 into the carrying case — no way! In the words of Zaphod, minus several million for planning.

The most interesting expansion option is the capability to drive a normal TV or monitor display from the HX-20. Now, the internal screen is formatted as being 16 lines of 32 characters although by using the BASIC WIDTH command this can be extended to 37 lines of 40 characters. As well as this text screen the HX-20 supports a graphics screen which would appear as 128 dots by 64 dots in four colour or 128 by 96 dots in Hi-Res. As yet Epson have not given a date for the release of this extra in the UK but I understand that Norbain, the main UK dealer organisation, are working on a compatible unit and this may well be ready by the Spring — prices are rumoured to be around £50.

TIME TRIALS

As always, we ran the standard Benchmark tests on the HX-20 and, somewhat surprisingly, it produced very reasonable results. I say surprisingly because I would have expected it to be of the same sort of speed as something like the PC-1500 system as it is a battery powered micro using CMOS ICs. However, although it won't win any prizes the HX-20 turns in the times shown in Table 1. On opening up the system for a close, internal look we find that it has two CPUs, both designated 6301, which are 6800 series with integral 4K monitor and 128 bytes of RAM plus 29 I/O lines each and a 16-bit timer. Now, inspection of the manuals reveals that, as expected, one looks after the major internal functions such as the keyboard and the LCD display while the other handles the external devices like the microprinter and microcassette. The fact that Epson have chosen to split the control of the system into these two sections is probably the main reason why the machine holds its head up so well in the Benchmark tables, it is actually faster than the ZX Spectrum on some counts!

As well as giving us an insight into the architecture of the machine the Benchmarks reveal something about the way that the BASIC has been written and, given the fact that the 6800 series is not the fastest of micros anyway we can safely say that the Epson BASIC is well written.

Benchmark	Time
BM1	2
BM2	15
BM3	33
BM4	33
BM5	35
BM6	60
BM7	102
BM8	132

Table 1. The Benchmark test results. These results are in seconds, timed with the internal clock.

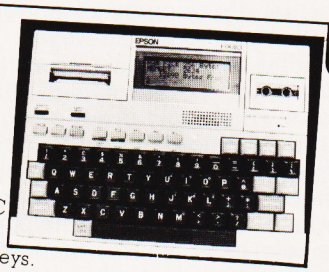
IN THE END

As a portable machine the Epson HX-20 can hardly be faulted, it possesses all the necessary interfaces and language functions to enable it to perform its tasks in the field and, in the weeks of use that I've given it I have yet to experience an error or system crash. So, we have a reliable, portable micro but is it worth the money?

Certainly there is a British alternative, the NewBrain from Grundy which is somewhat cheaper although it doesn't have a built-in cassette or printer. Then there's the Husky but that is much more expensive and rather outside this market. On the hand-held front we have the latest from Sharp, the PC-1251, which has a built-in printer and cassette but is slower and has less memory and a smaller display — it is significantly cheaper though. A British company could probably take the NewBrain, shoehorn it into a new case with a microcassette and printer and produce a similar product for around the same price. So if a small volume UK version can be made for around £500 why does the mass manufactured Japanese cost so much? Probably because that is what the market will stand!

So, if Epson take the HX-20, trim the price to around £300 (or even less) and offer the range of peripherals required such as a full TV display adaptor and discs for the office along with the software your portable micro user will want it becomes a very attractive machine. But, and it's a big but really, why do you want a portable micro? A salesman wants one to record his orders, an engineer wants one to record data and results and, just possibly, a businessman might want one to take home to do some work on. A serious user will find it too slow compared with a 'standard' machine, a student will probably opt for something like the PC-1500 or even the smaller PC-1251 (or, of course, their Casio counterparts).

It is very sad to reflect that despite its undoubted technical excellence and attractive styling the HX-20 may have priced itself into a market that doesn't really exist in sufficient quantity to make the machine a success.



FACTSHEET Epson HX-20

CPU	CMOS 6301 (2 off)	
Clock	0.6MHz	
ROM	32K	
RAM	16K	
Language	Extended Microsoft BASIC	
Keyboard	68 key QWERTY.	
	Five user programmable keys.	
	Editing and cursor controls.	
	Pseudo numeric keypad facility	
Display	Four lines of 20 characters LCD.	
	120 by 32 points in graphics mode.	
	User configurable virtual text screen.	
	34 pre-defined graphics characters.	
Cassette	32 user definable graphics characters	
	Integral microcassette.	
I/O	External audio cassette interface	
	Simple serial port plus full RS232 port.	
	Barcode reader port.	
	Full bus expansion capability.	
Options	Integral 24-column microprinter	£80 + VAT
	16K RAM module	£80 + VAT
	16K RAM/16K ROM module	£220 + VAT
	Accoustic coupler	£TBA
Costs	TV display adaptor	£411 + VAT
	Epson HX-20	(microcassette extra

Supplier Epson (UK) Ltd
Dorland House, 388 High Road,
Wembley
Middlesex HA9 6UH
01-900 0466

sinclair
ZX Spectrum
BLUE EDIT
RED CAPS LOCK
MAGENTA TRUE VIDEO
GREEN INV. VIDEO
CYAN
YELLOW
WHITE
GRAPHICS
BLACK DELETE
1 ! DEF FN
2 @ FN
3 # LINE
4 $ OPEN #
5 % CLOSE #
6 & MOVE
7 ' ERASE
8 (POINT
9) CAT
0 _ FORMAT
SIN COS TAN INT RND STR$ CHR$ CODE PEEK TAB
Q <= PLOT ASN
W <> DRAW ACS
E >= REM ATN
R < RUN VERIFY
T > RAND MERGE
Y AND RETURN
U OR IF
I AT INPUT
O ; POKE OUT
P " PRINT
READ RESTORE DATA SGN ABS SQR VAL LEN USR
A STOP NEW
S NOT SAVE
D STEP DIM
F TO FOR
G THEN GOTO
H ↑ GOSUB CIRCLE
J − LOAD VAL $
K + LIST SCREEN $
L = LET ATTR
ENTER
LN EXP LPRINT LLIST BIN IN KEY$ PI
CAPS SHIFT
Z : COPY BEEP
X £ CLEAR INK
C ? CONT PAPER
V / CLS FLASH
B * BORDER BRIGHT
N , NEXT OVER
M . PAUSE INVERSE
SYMBOL SHIFT
BREAK SPACE

Sinclair ZX Spectr

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power– personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

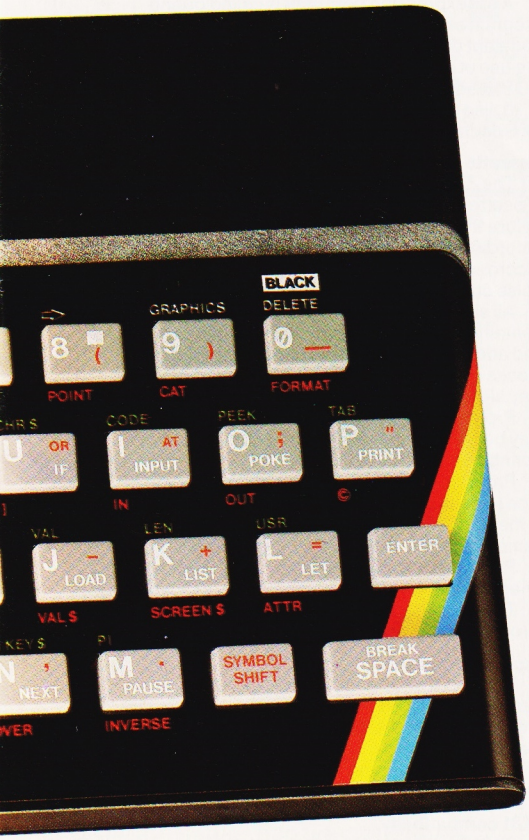
Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.

Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um



ZX Spectrum software on cassettes – available now

The Spectrum software library is growing every day. Subjects include games, education, and business/household management. Flight Simulation...Chess...Planetoids...History...Inventions...VU-CALC...VU-3D...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

sinclair

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS.
Tel: Camberley (0276) 685311.

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

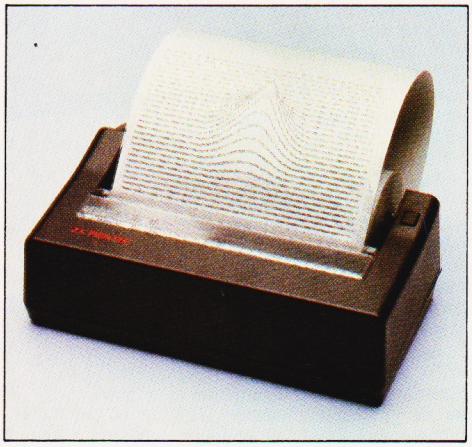
The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.



How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard, Access or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

Please tick if you require a VAT receipt ☐

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £ _____

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

COT 903

FREEPOST – no stamp needed. **Prices apply to UK only.** **Export prices on application.**

Sinclair ZX Spectrum–technical data.

Dimensions

Width	233 mm
Depth	144 mm
Height	30 mm

CPU/ memory

Z80A microprocessor running at 3.5 MHz. 16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/ speaker.

Graphics

Point, line, circle and arc drawing commands in high-resolution graphics.
16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive–or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red, magenta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section – normally the first 22 lines – displays the program listing or the results of program or command execution. The bottom section – normally the last 2 lines – shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

Mathematical operations and functions

Arithmetic operations of +, –, ×, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary – giving a range of $+3\times10^{-39}$ to $+7\times10^{38}$ accurate to $9\frac{1}{2}$ decimal digits.

Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL$, STR$ and LEN. CHR$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a$ (x TO y).

Variable names

Numeric – any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).
String – A$ to Z$.
FOR-NEXT loops – A-Z.
Numeric arrays – A-Z.
String arrays – A$ to Z$.

Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

ZX81 programs may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics; using LLIST, LPRINT and COPY.
ZX81 software cassettes and the ZX 16K RAM pack will not operate with the ZX Spectrum.

sinclair

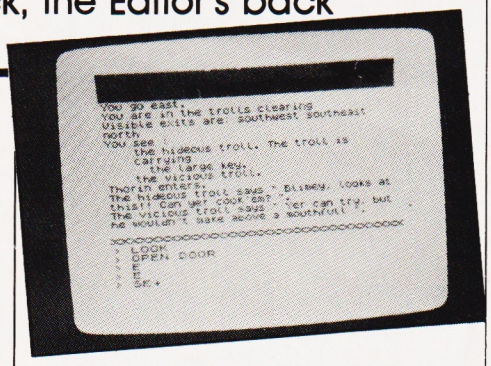
ZX Spectrum

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey, GU15 3PS. Tel: Camberley (0276) 685311.

Henry Budgett

#FILE

Following last month's non-appearance of this column you might have hoped that it had gone for good . . . No such luck, the Editor's back again!



It seems strange having to write one's article for the last issue of the first quarter of the year when one has only just recovered from the excesses of Christmas and the New Year but, that's journalism for you! Planning and working so far in advance, as indeed we have to on a monthly publication, often causes problems of immediacy. For example, over the last few weeks I've been testing out a couple of new games; The Hobbit for the ZX Spectrum and Star Maze for the Apple II. Now, as far as I'm concerned, you can't really write a full report on a product like this until you have either beaten it completely or accepted that you are simply not smart/fast/co-ordinated enough to get better scores. So, when I read reviews of a product where the author proudly states that he completed 7.5% of a certain game and I happen to know that this score can be achieved in less than 30 moves I begin to wonder whether it's worth trying to get further into the game and then write the report or just give up and write it anyway!

ON THE TRAIL OF ADVENTURE

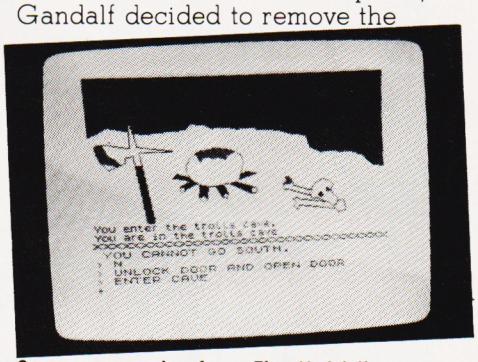
I thoroughly enjoy adventure-type games, I'm not necessarily much good at them but it's rather like a crossword puzzle in that once I've started I keep going back to try a bit more. The Hobbit, recently introduced by Melbourne House to a great fanfare of trumpets is claimed to be more than your average adventure. In short, the game not only plays with you, it plays with itself as well (I thought you could be locked up for things like that). Melbourne House claim that the game possesses some degree of 'intelligence' and, indeed it does allow you to do things that other games of this genre don't; for example you can string commands together in the form:

Take the large key AND go north AND unlock door AND open door.

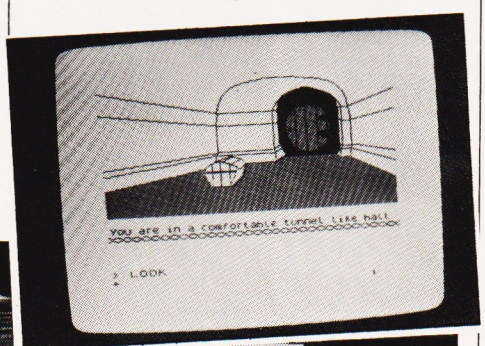
You can also converse in a limited way with the other characters in the game although all Thorin ever seems to do is tell you to 'Hurry Up' or simply sit down and sing about treasure! Although the game is primarily a text-only type each major location you discover (stumble across) is illustrated rather prettily in the Spectrum's high resolution graphics.

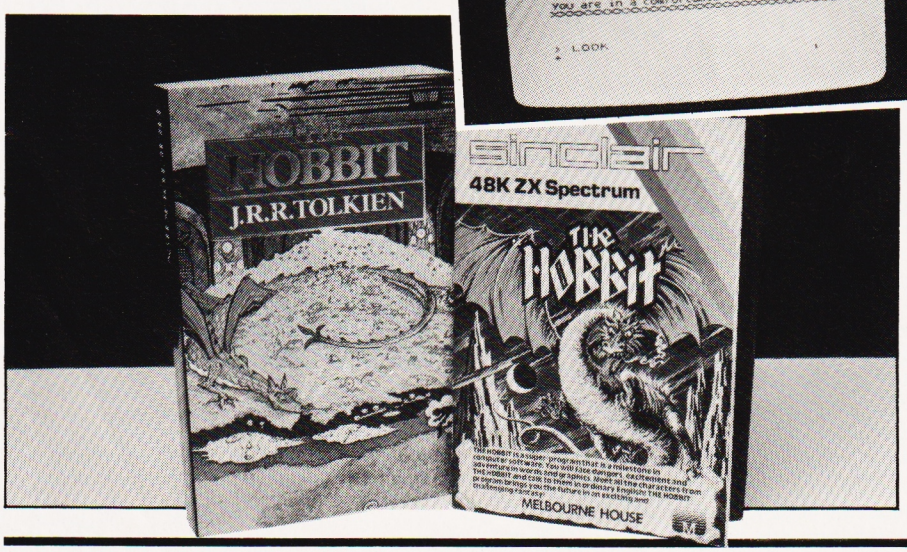
This does break up the monotony and is probably quite cheap in terms of memory usage as several of the scenes get duplicated. However, if they hadn't used graphics they might have fitted it into the 16K ZX Spectrum and hence sold rather more.

I must confess to having had a lot of fun getting as far as I have, although to be honest I haven't finished it yet, but I can see flaws in the game design in one or two places. A wonderful example of this occurred one afternoon when, on re-starting the game as a result of a fatal encounter with a spider, Gandalf decided to remove the round green door from my hobbit's hole and spent the rest of the game walking round with it! I'm sure ***he*** thought that it was a great idea but . . . The game does allow you to store your current status on tape and re-load it when convenient (ie when you die unhappily in the goblin's tunnels) and also includes a facility to dump the progress of the game onto a ZX Printer provided you can stand the noise. One day, perhaps, I'll get to do battle with Smaug, I just hope the results are worth it!



Some examples from The Hobbit. Melbourne House even throw in a copy of the book for reference.





GETTING AMAZED

Sometimes I get sent a piece of software which turns out to be really original in concept and execution, unlike much of the material which passes through these days. A couple of months ago a disc of American games software arrived that is still being actively played and, within these offices at least, is regarded as being really rather good. Called Star Maze it originates from Sir-tech Software Inc of New York State and runs on the Apple II. In

The Editor's well-used Apple II, yes we actually use the computers we write about!

the accompanying letter the company stated that this was their first arcade game and that they had taken some six months just refining it to ensure that you wanted to play it more than once. Well, they certainly achieved that! If you take the ingredients of a maze, a quest, a 'zap the aliens' and an asteriods type game and then add them all together you would, just possibly, have something like Star Maze. Ideally it needs to be played in colour as the maze is coloured and it would be easier to find your way around but even in good old black and green it's great fun. The idea is that you start off on Level 1 with three ships, three smart bombs and a relatively easy maze. You must collect all nine jewels which are scattered around and return them to your mother ship. On the way you score points by killing off various types of alien craft and breaking up the asteroids. Points are also gained for returning the jewels and completing a level quickly. Sounds easy? Perhaps I should have said that there are 16 levels and not even our resident 40-fingered games genius has got past Level 4 yet!

As an indication of the kind of thought that has gone into producing the game you can initialise it to use either the standard Apple keyboard, Apple paddles, Atari joysticks through a 'joyport' or even a custom joystick of your own. The current best 10 scores are held on disc and, just in case you have an accident, a back-up copy is provided on the flip side of the disc. Using the Apple's Hi-Res graphics together with defined shapes makes the game a joy to look at, although long persistence screens tend to make it a bit 'swimmy'. Star Maze probably represents the best all-in-one game of the arcade type I've yet seen on a micro, it looks simple to play and yet demands an awful lot more concentration and downright skill than many of the simply repetitive 'zap as many as quickly as you can' offerings.

I have no idea when or where you'll get a copy in the UK but if you fancy a go you can order direct from Sir-tech at 6 Main Street, Ogdensburg, NY 13669. The price is $34.95 and you'll need an Apple II with 48K and a disc running under DOS 3.3.

A QUICK CAVEAT

Just before I depart for the month I thought that the following item of intelligence might be of more than passing interest to some of you. If you are using a micro at home with a rented TV set dig out your rental documents NOW. It appears that some contracts include clauses prohibiting you from connecting anything (apart from the aerial!) to that TV without the written approval of the rental company. This rather nasty fact was pointed out recently to a gentleman whose BBC Micro had developed a terminal case of non-operability after being plugged into the back of his rented set. No damage to the TV mind but the BBC's main PCB was in rather a mess.

Presumably these restrictions don't apply to anything else that you've rented from the company; video recorders, TV games and the like but it would be well worth checking the situation out carefully. If you find a similar clause in your contract I suggest you go and have a word with the local office and find out what the actual requirements are to connect a small computer to the TV as, if anything did go wrong you could either be faced with a bill from the rental company for their TV set or, worse still, a dead micro that nobody wanted to know about.

A typical display from the game. The mother-ship is the square ship just above the player's dart shaped craft. An attacking scout is approaching top right together with some meteor debris.

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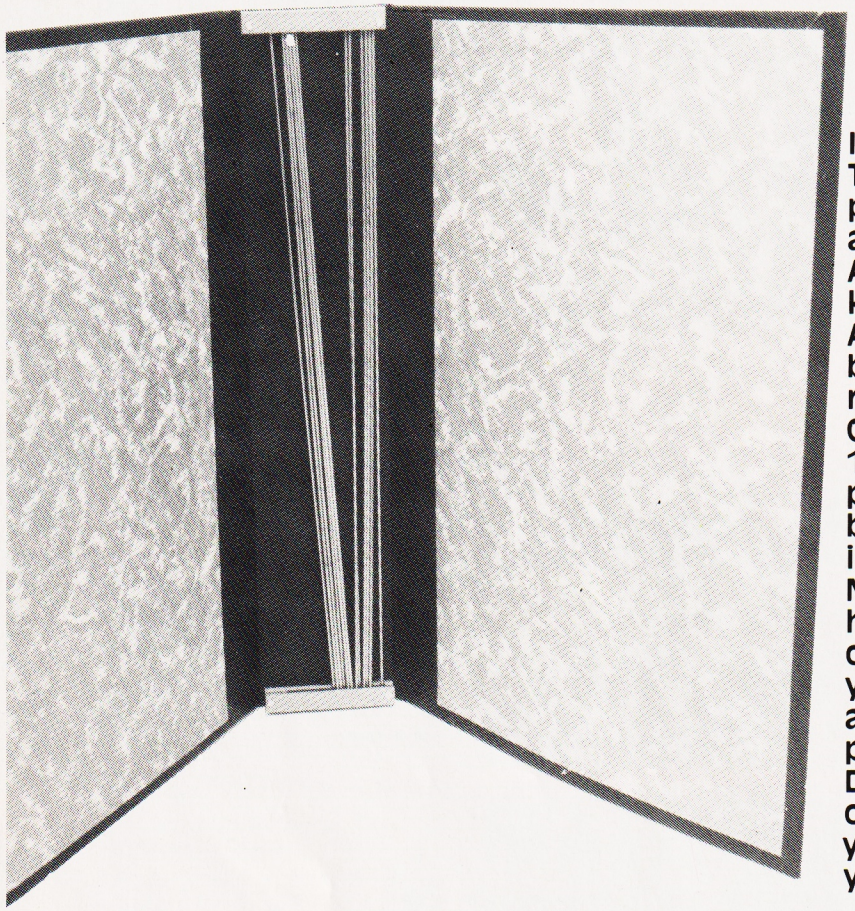

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CT March '83

Don Thomasson

PEEKING THE SPECTRUM

Trying to PEEK into the Spectrum's memory can cause all sorts of problems. Here we show how to do this without all of the headaches.

The Spectrum is an interesting machine in many ways, but it has one characteristic which can be infuriating. Where a memory mapped display allows the character in a given screen position to be determined by a simple PEEK into memory, the Spectrum display store is arranged in what appears, at first sight, to be a totally chaotic manner, and PEEKs provide no useful information. The manual warns the user of this, and suggests the use of SCREEN$ as an alternative, but that is no use with user-defined graphics, which are seen as spaces.

A little patient experiment shows that the eight bytes forming the character at the top left corner of the screen are held in locations:

16384
16640
16896
17152
17408
17664
17920
18176

16384 is the start of the display memory area, and the other addresses are obtained by adding 256 successively. Ah! So we can write:

Address = 16384 + 256*(n−1) + 32*x + y = 16128 + 256*n + 32*x + y

Where the address contains the nth byte of the character in line x column y.

UNBLOCKING THE SCREEN

But this fails after eight screen lines have been examined. An entirely new block starts, 2048 locations after the first, and we have;

Address = 18176 + 256*n + 32*(n−8) + y = 17920 + 256*n + 32*x + y.

After a total of sixteen lines, a third block starts, and we have;

Address = 20224 + 256*n + 32*(x−16) + y = 19712 + 256*n + 32*x + y.

It's just as well we have a computer handy, but what good will that do us? The program given here provides an indication of the answer.

Input a number, and the screen fills with characters. Then a scan starts, in which the eighth byte of each character is compared with the number which was input. If the two are equal, the character is converted to reverse video by PRINT OVER. Otherwise, the character remains unaltered. Input zero, and most of the characters will change. Those which do not are characters with descenders, with at least one high bit in the last byte. Input 56, and p and q will be picked out. To save tedious experiment, the numbers worth trying are 0, 6, 8, 16, 24, 32, 56, 60, 64 and 255.

The second input allows you to state a colour and then another check number, so that you can put a colour against a specific last byte. Not a particularly useful program, but quite amusing.

Now create some user graphics and extend the original program so that it prints them, by changing the 95 entries to 132. If you use a bit of craft, you can make the lowest line of each special graphic give a different number, preferably not one in the list given above. The program will then pick out this number, identifying each graphic individually.

For a program like The Valley, a somewhat different routine is needed. The current values of x and y are known, so all that needs to be done is to define the base and perform the PEEK. The rest of the program could be almost identical with the original.

It need scarcely be said that the byte examined need not be the last one forming the character. If the graphics make a different byte more convenient, all that needs doing is a change in BASE value.

At a guess, the SCREEN$ function may compare the bytes which it reads from the character with the character pattern data stored near the top of the ROM. It would be possible to perform the same trick with the special graphics data, but that would probably be an overkill. However, there may be cases which would make that worth while, though machine code would be necessary to keep the response time down.

Have fun!

```
 10  INPUT N
 20  LET A=0
 30  LET B=INT(A/95):LET C=A-95*B
 40  PRINT CHR$(C+32);
 50  IF A<703 THEN LET A=A+1:GOTO 30
 60  INK 2
 70  FOR X=0 TO 21
 80  FOR Y=0 TO 31
 90  LET BASE=18176
100  IF X>7 THEN LET BASE=19968
110  IF X>15 THEN LET BASE=21760
120  LET D=(BASE+32*X+Y)
130  IF PEEK(D)=N THEN PRINT OVER 1;AT X,Y;"RV SP"
140  NEXT Y:NEXT X
150  INPUT M:INK M
160  INPUT N
170  GOTO 70
```

Listing 1. The Screenpeek program.

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SIZE	SQR		*	ENTER	MAG
CONT	SYS	STATEMENTS	UNIT	LIST	TOF
MON	TIC	IF	BAUD	PURGE	TON
	SQN	ELSE	CALL	NUMBER	DIM
FUNCTIONS	BIT	ON	DATA	RENUM	DEF
ABS	CRB	GOTO	READ	BOOT	NEW
ADR	CRF	GOSUB	RESTOR	GRAPH	END
ASC	MEM	POP	RETURN	TEXT	BIT
ATN	MWD	REM	STOP	PLOT	CRB
SIN	LEN	FOR	TIME	UNPLOT	CRF
COS	MCH	NEXT	WAIT	COLOUR	MEM
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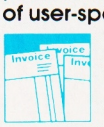

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INTO ATARI'S BASIC

In response to overwhelming demand from Atari owners we take an in-depth look at the workings of that machine's BASIC.

The Atari 400 and 800 computers have been on sale in this country for some months now and I know that they have sold in substantial numbers. So — Atari Programmers — WHERE ARE YOU!!?

Where are all the programs, the hints and tips, the sneaky PEEKs and POKEs that proliferate from our fellows on their ZX80/1s, ATOMs, VICs ***et al?*** For if ever there was a machine that needed a little exposure, the Atari is it. There is a wealth of hardware and software sophistication under its bonnet which belies its unfortunate and undeserved 'games machine' image.

I have decided to try and redress the balance slightly by sharing my discoveries about Atari BASIC. Also, I offer this in the hope that it will stir up you other Atari owners out there to put print-head to paper for the good of Atari users and for those poor unfortunates who have not yet seen the light.

LINE CONVERSION

When a line of text is typed in followed by Return, the BASIC interpreter begins a conversion routine to reduce the program line to a standard format before it is stored in RAM. This method differs from that employed by many other BASIC interpreters in which the line is stored almost letter for letter as it is typed. One result of this is that the Atari will pick up most syntax errors as they are typed in rather than at run time — a significant advantage.

The conversion routine looks for the BASIC reserved words and, on finding one or more, converts them to a single byte number representing the word. This process is known as tokenisation, the number assigned being the token.

All variables in the line are also tokenised to a single byte number between 128 and 255. If the variable has already been encountered, it is replaced with the number originally assigned, otherwise it is assigned the next available number. The full variable name is stored in another part of RAM in the variable names list (more of this later) so that it may be reproduced in program listings.

Finally, all numeric constants are converted to a six byte number and string constants are converted into ASCII code before storage. Constant storage is discussed in more detail later.

When conversion is complete, the now formated line is stored in memory. If it has a line number, it will be stored in the correct place in the program area. If no line number is used, the immediate execution mode is assumed and the line is executed.

STORED LINE FORMAT

The best way to show the format is by example. This simple, single-statement program line:

```
10  PRINT A
```

converts to the following list of numbers in consecutive locations in memory:

Byte	1	2	3	4	5	6	7
	10	0	7	7	32	128	22

The table below gives more details. The line number for the next line in the program follows on immediately after the previous line terminator.

Byte number	Function
Bytes 1 and 2	This is the two-byte line number stored in 'low byte first, high byte second' format, ie: 10 + (0 X 256) = 10
Byte 3	The third byte always contains the total number of bytes used to store the complete line in its converted form, in this case, seven.
Byte 4	This contains the number of bytes in the first statement of the line. As there is only one statement in the example, bytes 3 and 4 contain the same number.
Byte 5	This is the token from the BASIC reserved word 'PRINT' (the space after the line number is not stored).
Byte 6	This is the number that has been assigned to the variable A. As it is the first variable of the program, the interpreter assigns the first variable number 128. The next variable encountered will be assigned 129 and so on.
Byte 7	All Atari BASIC lines except REM and DATA lines are terminated by 22. This ensures that, at run time, execution of the line stop before the next line number is encountered.

A byte-by-byte breakdown of the BASIC statement, 10 PRINT A. ▶

STRING CONSTANTS

This program line:

```
20  PRINT "HELLO"
```

converts to the following list of numbers:

Byte	1	2	3	4	5	6	7	8	9
	20	0	13	13	32	15	5	72	69
	10	11	12	13					
	76	76	79	22					

Byte 5 is the token for PRINT as before but now this is followed in byte 6 by the token 15 which identifies the following string constant. Byte 7 contains the number of characters in the string and this is followed by five character codes (bytes 8-12) representing the word 'HELLO'. These are ATASCII codes, which means that they conform to an Atari modification of the American Standard Code for Information Interchange (ASCII). A table of these codes may be found in Appendix C of the **Atari BASIC Reference Manual.**

Finally, the terminator 22 ends the line.

NUMERIC CONSTANTS

In the following program line and its encoded version, byte 6 is 14 which identifies a numeric constant.

```
15  PRINT 123
```

Byte	1	2	3	4	5	6	7	8	9
	15	0	13	13	32	14	65	1	35
	10	11	12	13					
	0	0	0	22					

Atari BASIC stores all numeric constants as a six byte value. The exact method of number representation used is complex but briefly, for the mathematicians amongst you, the first byte of the number (byte 7 in this case) contains the exponent as powers of 100 in excess 64 form. The remaining five bytes represent the mantissa as two BCD digits per byte with the integer part always held in the first of these five bytes. Therefore, the above number is decoded as follows:

```
100^(65-64) = 100^1 = 100*1.23 = 123
```

(The '23' part of the number is stored as BCD in byte 9. When 'PEEKing' this location, the BASIC interpreter assumes a binary value and converts this to the decimal equivalent, ie 35).

While this method may seem over-complex, it does allow numbers of 10 significant decimal digits to be stored in only six bytes (although Atari BASIC only extends to nine significant digits).

MULTIPLE STATEMENT LINES

The following conversion is an example of a multiple statement line.

```
10  FOR A=1 TO N:PRINT A:NEXT A
```

Byte	1	2	3	4	5	6	7
	10	0	25	17	8	128	45
	8	9	10	11	12	13	14
	14	65	1	0	0	0	0
Byte	16	17	18	19	20	21	22
	129	20	20	32	128	20	25
	23	24	25				
	9	128	22				

The line is interpreted as follows:

Byte	Value	Representation
1&2	10	Line number
3	25	No. of bytes in converted line
4	17	No. of bytes in first statement
5	8	Token for FOR
6	128	Assigned number for variable A
7	45	Token for =
8	14	Token indicating numeric constant
9-14		Numeric constant (value 1)
15	25	Token for TO
16	129	Assigned number for variable N
17	20	Token for : (statement terminator)
18	21	No. of bytes in first two statements
19	32	Token for PRINT
20	128	Variable A (pre-assigned)
21	20	Token for : (statement terminator)
22	25	No. of bytes in first three statements
23	9	Token for NEXT
24	128	Variable A (pre-assigned)
25	22	Line terminator

After each statement terminator the interpreter expects to find a tally of the number of bytes in the statements encountered so far. When this number matches that of byte 3, it knows that the current statement is the last in that line. Figure 1 shows the general line storage format.

Table 1 is a list of all the tokens that I have encountered so far. I believe that it is complete but you may be able to find others that I have missed. Some numbers have two meanings and are interpreted differently depending on whether they begin the statement or appear later. There are four '=' sign tokens to distinguish between the different functions implied by its use in BASIC.

34 is used as the token in arithmetic testing, for example:

```
IF N=36 THEN END
```

45 is used for arithmetic assignments such as:

```
N=A+10
```

46 is used when a string assignment is encoded, eg:

```
A$="ATARI"
```

Finally, 52 is similar to 34 except that it is used when testing strings, eg:

```
IF ANSWER$="YES" THEN GOTO 50
```

MEMORY ORGANISATION

Figure 2 shows the manner in which Atari BASIC utilises the RAM memory. Allocation of memory is dynamic with the boundaries between different sections varying as the program grows or diminishes as a result of user entries.

In order to keep track of the boundaries, pointer addresses are stored in the zero-page locations indicated in the diagram.

For example, to find the address of the beginning of the variable names List, the following line of code may be used:

```
100  NAMELST=PEEK(130)+PEEK(131)*256
```

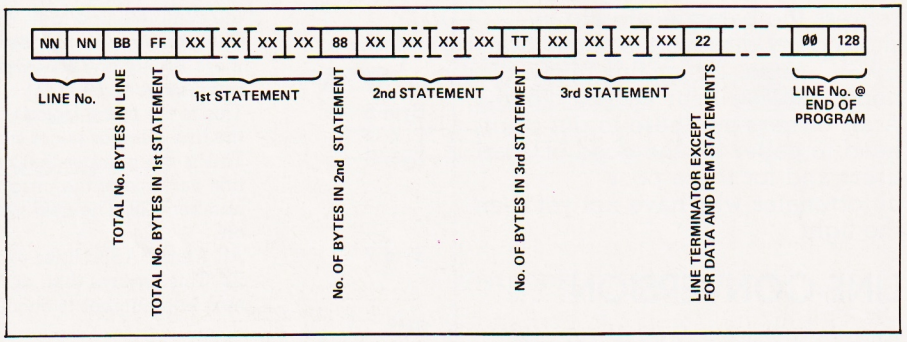

Fig. 1. The way Atari BASIC lines are stored in memory.

Beginning of statement		Inside statement	
1	DATA	20	:
2	INPUT	21	;
3	COLOR	22	
4	LIST	23	GOTO
5	ENTER	24	GOSUB
6	LET	25	TO
7	IF	26	STEP
8	FOR	27	THEN
9	NEXT	28	#
10	GOTO	29	<=
11	GO TO	30	<>
12	GOSUB	31	>=
13	TRAP	32	<
14	BYE	33	>
15	CONT	34	=
16	COM	35	↑
17	CLOSE	36	*
18	CLR	37	+
19	DEG	38	-
20	DIM	39	/
21	END	40	NOT
22	NEW	41	OR
23	OPEN	42	AND
24	LOAD	43	(
25	SAVE	44	)
26	STATUS	45	=
27	NOTE	46	=
28	POINT	47	<=
29	XIO	48	<
30	ON	49	>=
31	POKE	50	<
32	PRINT	51	>
33	RAD	52	=
34	READ	53	+
35	RESTORE	54	-
36	RETURN	55	(
37	RUN	56	
38	STOP	57	
39	POP	58	(
40	?	59	(
41	GET	60	,
42	PUT	61	STR$
43	GRAPHICS	62	CHR$
44	PLOT	63	USR
45	POSITION	64	ASC
46	DOS	65	VAL
47	DRAWTO	66	LEN
48	SETCOLOR	67	ADR
49	LOCATE	68	ATN
50	SOUND	69	COS
51	LPRINT	70	PEEK
52	CSAVE	71	SIN
53	CLOAD	72	RND
54	(IMPLIED LET)	73	FRE
55	ERROR	74	EXP
		75	LOG
		76	CLOG
		77	SQR
		78	SGN
		79	ABS
		80	INT
		81	PADDLE
		82	STICK
		83	PTRIG

Table 1. The Atari BASIC tokens.

Each time a new variable is encountered, the full name is entered into the variable names List and this is the only time it is stored in its full form. The first and all subsequent references to it within the stored program are by the assigned token as already described.

```
32600  REM ** PROGRAM TO LIST
       CONTENTS
32610  REM ** OF VARIABLE NAMES LIST
32620  NAMELST=PEEK(130)+PEEK
       (131)*256
32630  CHAR=PEEK(NAMELST)
32640  IF CHAR=0 THEN END
32650  PRINT CHR$(CHAR);
32660  NAMELST=NAMELST+1
32670  GOTO 32630
```

Listing 1. This will dump all the variables currently held in the machine.

The names are held as a sequence of ATASCII code numbers with values between 0 and 127. The last character of a name is identified by the addition of a further 128 to the character code. If the names are printed to the Atari screen, this results in the last character of each variable name appearing in reverse video.

Listing 1 will print all the variables currently held in the machine.

VARIABLE STORAGE AREA

At the same time, for each new variable, eight bytes are allocated in the variable storage area. In the case of a simple numeric variable, six of the eight bytes contain the numeric value in the form discussed earlier.

For example, the number 17000 may appear in the variable storage area as illustrated below:

Byte	1	2	3	4	5	6	7	8
	0	15	66	1	7	0	0	0

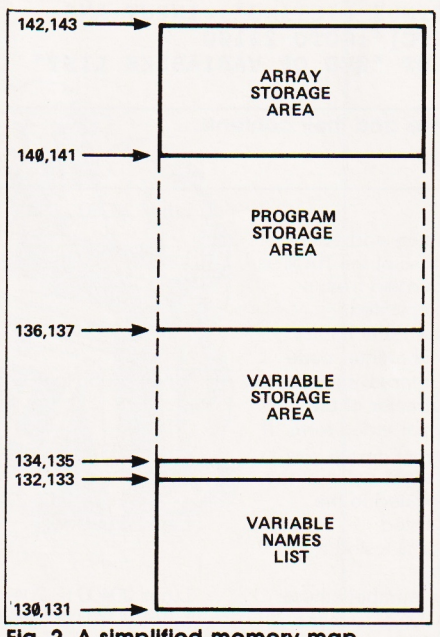

Fig. 2. A simplified memory map showing the various program and varable storage areas and the location of their pointers in Zero page.

Byte 1 identifies the variable type ie:

0 = Simple Numeric Value
64/65 = Numeric Array
128/129 = String

Byte 2 is a variable identification number which is assigned in order of appearance. In the example above, it was the fifteenth variable typed in. Bytes 3-8 contain the variable value. For strings and numeric arrays, however, the values are not contained in these eight bytes but in the array storage area. The eight bytes contain instead the start address and the length of the memory block in the array storage area used to store the values.

For example, a string variable may produce the following block of eight bytes in the variable storage area:

Byte	1	2	3	4	5	6	7	8
	129	4	92	0	32	0	40	0

Byte 1 identifies a string variable and byte 2 is the assigned identification number as before. Bytes 3 and 4 give the start address of the memory block in the array storage area which holds the value of the string. It is in the form of an offset giving the number of bytes from the start of the array storage area. (The address contained in locations 140 & 141.) Bytes 5 and 6 indicate the actual length of the string. Bytes 7 and 8 contain the dimensioned length of the string which is also the number of bytes allocated in the array storage area for the string value.

Numeric arrays are slightly different again. After execution of the following program line, for instance:

```
100  DIM TABLE(6,9)
```

the eight bytes in the variable storage area would look something like this:

Byte	1	2	3	4	5	6	7	8
	65	10	89	0	7	0	10	0

As with the string variable, byte 1 identifies the variable type; this time an array is indicated. Byte 2 is the identification number and bytes 3 and 4 tell the interpreter that the first byte of the first element of the array may be found 89 bytes in from the start of the array storage area. (This number, of course, like that in byte 2, will vary from program to program.) ▶

```
20000  REM ** ROUTINE TO LIST PROGRAM VARIABLES AND THEIR
       VALUES
20010  DIM AN$(1):AN$="[SPC]":COUNT=0
20020  REM ** GET IMPORTANT ZERO PAGE POINTERS
20030  NAMELST=PEEK(130)+PEEK(131)*256
20040  VARISTORE=PEEK(134)+PEEK(135)*256
20050  ARRAYSTORE=PEEK(140)+PEEK(141)*256
20060  GRAPHICS 0:PRINT CHR$(125):REM ** CLEAR SCREEN
20070  POSITION 12,0:PRINT "VARIABLES LIST"
20080  PRINT "NUMBER","NAME","[3 SPC]VALUE":PRINT:PRINT
20090  REM ** PRINT VARIABLE NUMBER
20100  PRINT COUNT+128
20110  REM ** PRINT VARIABLE NAME
20120  VCHAR=PEEK(NAMELST):IF VCHAR=0 THEN GOTO 20450
20130  NAMELST=NAMELST+1
20140  IF VCHAR<128 THEN PRINT CHR$(VCHAR);:GOTO 20120
20150  PRINT CHR$(VCHAR-128),
20160  POSITION 25,PEEK(84)
20170  STORADD=COUNT+8+VARISTORE
20180  REM ** TEST FOR NUMERIC VARIABLE
20190  IF PEEK(STORADD)<>0 THEN GOTO 20350
20200  REM ** GET POWER AND TEST FOR ZERO
20120  POWER=PEEK(STORADD+2):NUMBER=0
20220  IF POWER=0 THEN 20340
20225  IF POWER>127 THEN ? "-";:POWER=POWER-128
20230  POWER=POWER-64:DIV=1
20240  REM ** BUILD NUMBER FROM 10 BCD DIGITS
20250  FOR LOC=STORADD+3 TO STORADD+7
20260  TENS=INT(PEEK(LOC)/16):REM ** LEFT DIGIT
20270  UNITS=PEEK(LOC)-TENS*16:REM ** RIGHT DIGIT
20280  NUMBER=NUMBER+(TENS*10+UNITS)/DIV
20290  DIV=DIV*100:NEXT LOC
20300  IF POWER<0 AND POWER>-5 THEN
       NUMBER=NUMBER*100^POWER
20310  IF POWER>=0 AND POWER<5 THEN
       NUMBER=NUMBER*INT(100^POWER+0.5)
20320  IF POWER>5 OR POWER<-5 THEN PRINT NUMBER;"E";
       POWER:GOTO 20420
20340  PRINT NUMBER:GOTO 20420
20350  REM ** HERE IF STRING OR ARRAY
20355  Z=PEEK(STORADD)
20360  IF Z=64 OR Z=65 THEN PRINT "ARRAY":GOTO 20420
20370  ARRAYOFFSET=PEEK(STORADD+2)
20380  STRADD=ARRAYSTORE+ARRAYOFFSET
20390  SLENGTH=PEEK(STORADD+4)+PEEK(STORADD+5)*256
20400  FOR LOC=STRADD TO STRADD+SLENGTH-1
20410  PRINT CHR$(PEEK(LOC));:NEXT LOC:PRINT
20420  COUNT=COUNT+1:IF COUNT/15<>INT(COUNT/15) THEN
       GOTO 20100
20430  PRINT "TYPE 'Y' TO CONTINUE LISTING",:INPUT AN$
20440  IF AN$="Y" THEN AN$="[6SPC]":GOTO 20100
20450  POSITION 2,PEEK(84):PRINT "END OF VARIABLES LIST"
20460  END
```

Listing 2. This program lists the variable names and their contents.

Below: The detailed breakdown for Listing 2.

Line	Function
Lines 20030 to 20050	This code finds the boundary addresses between the various sections of the RAM.as
Line 20100	The variable number is derived from a running tally count and is printed.
Lines 20120 to 20150	The characters from the variable names List are printed. When a character code greater than 127 is encountered, the loop is broken and the last character of the word is printed in its normal video form. If
Line 20160	PEEK(84) returns the current cursor row.
Line 20170	This finds the first of the eight bytes in the variable storage area allocated to the variable currently being listed.
Line 20190	The first of the eight bytes is tested to identify the variable type.
Lines 20200 to 20340	If the variable is a simple number, these lines are executed. Line 20220 tests the power of the number and if it is zero then the number must be zero, and it is simply printed. Line 20225 tests for a negative power.
Line 20230	The excess 64 is subtracted from the power value.
Lines 20250 to 20290	The five locations containing nine decimal digits in packed BCD form are converted to a single decimal number.
Lines 20300 to 20320	These lines determine the print format of the number and minimise rounding errors.
Lines 20355 to 20360	If the first byte of the eight held in the variable storage area contains 64 or 65, this indicates an array.
Lines 20370 to 20380	These lines calculate the start address of the full value of the string or array in the array storage area (STRADD).
Line 20390	The length of the string or array, SLENGTH, is obtained from the fourth and fifth bytes of the eight.
Lines 20400 to 20410	The string or array is printed.
Lines 20420 to 20440	The running count is incremented. After printing 15 variables, the program executes line 20430 and waits for input to continue.

Bytes 5 and 6 contain the DIMed size of the first dimension of the array plus one (to account for element 0). Bytes 7 and 8 contain the DIMed size of the second dimension of the array plus one. If the array has just one dimension (eg TABLE(20)), byte 7 will be one.

USING THE INFORMATION

It is often useful, particularly when writing and debugging long programs to be reminded of the variable names that have already been used. Also, when something goes wrong in a routine, it can be very helpful to break the execution with a STOP command and then be able to 'dump' the variables and their values.

The program in Listing 2 does just that. Type the program into the machine in the usual way and then LIST it to cassette or disc. To use it, ENTER the program and it will be appended to your program under development. Type GOTO 20000 to execute. I have written the program to be as self-documenting as possible, but a few lines require further explanation: this is given at the bottom of the page.

IN PART TWO

Next month we'll be concluding our look at the way the interpreter works by presenting a simple 'partial' renumbering program. While this may not be the most sophisticated of utilities it's a whole lot better than having no renumber at all! We'll also be taking a look at the way in which you can use your knowledge of Atari's BASIC to create DATA statements within a BASIC program from the BASIC program itself.

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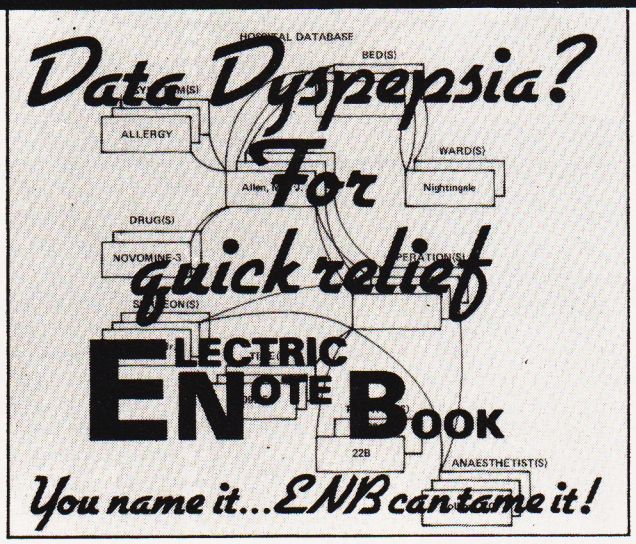

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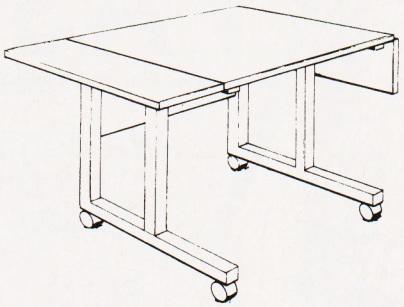

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Simon Goodwin

PROFILE PASCAL

We continue our series on programming in Pascal by explaining the way in which Pascal programs can be subdivided.

The larger a program becomes the more difficult it is to understand. If you've ever spent an evening tracing your way through a maze of GOSUBs and GOTOs in someone else's BASIC you'll be well aware of this. The problem is that every time you add a routine to a program you multiply the number of possible ways that the program could work — or, for that matter, fail. One of the key features of Pascal compared with BASIC is the way that it is possible to divide a program into small sections which can be easily understood. This month's article explains the way in which Pascal programs can be sub-divided.

DIVIDE AND CONQUER

In BASIC it is possible to simplify programs to some extent by the use of subroutines. The GOSUB statement is used to tell the computer to record the current line position and then jump to a different part of the program. Execution continues until a RETURN statement is found, at which point BASIC jumps back to the last line position recorded.

The advantage of GOSUB over GOTO is that it records the current line position so that the RETURN statement will always transfer control back to the statement after the GOSUB, regardless of the line from where the call took place. The computer uses a list to record the position of the statement following the GOSUB, so you can put a GOSUB inside a subroutine if you want to. RETURN will always jump back to the statement after the most recent GOSUB.

There are a number of snags about BASIC subroutines. Firstly, they are referred to by number rather than name, so that it is not immediately obvious what a given GOSUB will do. GOSUB 10000 could print a menu, sort a list into alphabetical order, clear the screen or play the national anthem. The only way to indicate the purpose of a subroutine is to add a comment after every GOSUB. It would be much more convenient if we could just say GOSUB PRINT MENU or simply GOD SAVE THE QUEEN.

PASCAL SUBROUTINES

In Pascal (with a few minor restrictions) you can give your subroutines sensible (or silly) names — you don't even need a CALL or GOSUB statement. If Pascal finds a word it doesn't recognise it assumes that it is the name of a subroutine and goes off to find it. The restrictions are that you may only use letters and numbers (no spaces) in your routine-name (it must start with a letter) and you mustn't use a name that Pascal also uses. You couldn't call a subroutine REPEAT, for instance, since Pascal would not know whether to start a loop or execute a subroutine. The Pascal compiler will tell you if any of your routine names aren't allowed.

Pascal allows two types of subroutine — ones that pass back a value (like SIN or ABS in BASIC) and ones that don't (like CLS or CLEAR). Figure 1 illustrates a simple Pascal subroutine definition.

```
PROCEDURE CLS;
BEGIN
  WRITE( CHR(28), CHR(31) )
END;
```

Fig. 1. This procedure will clear the screen.

A Pascal subroutine that doesn't pass back a value is called a 'PROCEDURE'. PROCEDURE CLS is set up to work on a Video Genie using Microcomputer Applications Pascal 80. The function CHR(n) works like CHR$(n) in BASIC, so that the procedure prints ASCII character 28 (move to top left of screen) and 31 (clear from current position to end of display). If you wanted to use the procedure in your main program you need merely type CLS in the appropriate place and Pascal would execute the instructions in the procedure. To convert the procedure for other computers you need only change the instructions inside the routine — in BBC Micro Pascal CHR(12) will move the cursor and clear the display. If your Pascal works with a standard DEC terminal you could use WRITE(CHR(27),'H', CHR(27),'J') to achieve the same effect.

You can have any statements you like in a procedure — not just WRITE. For instance you could clear the screen by printing blank lines. Figure 2 demonstrates this idea.

The new procedure CLS will work on any computer so long as there is a character-code which moves the cursor up a line and the

```
PROCEDURE CLS;

CONST PAGELENGTH=16; (* NO. OF LINES ON THE SCREEN *)
      CURSORUP=27; (* CURSOR MOVE CODE *)
VAR LINE:INTEGER;


BEGIN
  FOR LINE:=1 TO PAGELENGTH DO WRITELN;
  FOR LINE:=1 TO PAGELENGTH DO WRITE( CHR(CURSORUP) )
END;
```

Fig. 2. An alternative CLS procedure.

number of lines on the page is known. It works by filling the screen with blank lines and then moving the cursor up the screen over them. Notice that you can set up variables and constants at the start of a procedure just as you can at the start of a program. These are called 'Local' since the computer will forget about them as soon as it has finished executing the procedure — they only exist in one area of the program.

FORGETFUL PASCAL

At first sight it seems rather pointless for the computer to 'forget' local variables and constants at the end of a routine. In practice this facility is very useful. After a procedure has been executed Pascal can use its variable-space for something else — perhaps to store local variables for another procedure. Local variables also make it easy for variable names to be chosen. We can use LINE as a counter in this routine — somewhere else it could be used to store a line of characters. Pascal will not become confused if it comes across the re-definition of a variable. It simply saves the old value of LINE and sets up a new variable to store the latest value. As soon as it has finished with the line of characters (at the end of the routine that set it up) Pascal will rescue the old value and you can use it as if the renaming had never taken place.

This means that you can have lots of programmers independently working on parts of a program. So long as they set up locals they can use whatever names they like for variables, constants or types. Even if you're the only programmer working on a project you can set up names for new variables willy-nilly without having to search through your program to check that you haven't used them before. So long as you don't set up a name more than once in a given VAR section the program will run without confusion when all the routines are put together. The 'renaming' doesn't even slow Pascal down since the compiler works out where each variable is active before the program runs.

The CLS procedure can be used anywhere in a Pascal routine where a statement such as WRITE or READ would appear. It could even be called from within another procedure. The only restriction in standard Pascal is that you must declare the procedure (using the PROCEDURE statement) earlier in the listing than routines which use it. This explains why Pascal programs always seem so difficult to read when you're used to BASIC — they start near the bottom and work their way up towards the top of the listing as one routine calls another!

NO MALFUNCTION

Sometimes it is useful to be able to use subroutines inside arithmetic expressions. In BASIC these subroutines are called functions — ABS and INT are examples. Most functions take a value and pass back another one — for instance INT(7.3) passes back 7. Some functions require more than one value, or 'parameter'. The string function LEFT$(A$,3) takes two parameters — a string and a value — and passes back a string as its result. Pascal has some built-in functions — CHR converts a number into a character, and TRUNC converts a decimal number into an integer (like INT in BASIC).

In Pascal you can set up functions of your own. They can be called up inside WRITE statements (eg WRITE(MYFUNCTION(34))) or used in assignments (NUM:=MYFUNCTION(23)+23). You can pass any number of values to a function (even whole arrays!), so long as the function is set up to expect them. A function is just a procedure which returns a value — nothing more. The result returned can be decimal (REAL), whole-number (INTEGER), True or False (BOOLEAN) or a character (CHAR). Functions only return one value, but we will show how to get around that restriction later in this article.

Pascal normally passes information into a function or procedure by value. This is very important to remember, since it means that passing a variable as a parameter of a routine never results in a change in the value of the variable (even if the function or procedure messes about with the value of its copy). Later in this article we'll explain a way to give Pascal permission to adjust the value of a parameter. Normally this is not possible since Pascal takes a copy of all the parameters sent to a routine.

Functions are declared in much the same way as procedures, except the type of value which they pass back is specified on their first line. Figure 3 illustrates a complete program which uses a function. DEEPTHOUGHT is set up as a function which has no arguments — it's a simple example but it illustrates the way a function is set-up and used.

ANOTHER LAST ONE?

The routine works out the answer to the Ultimate Question of Life, the Universe and Everything. As listeners to the BBC series '*The*

```
PROGRAM ULTIMATE(OUTPUT);

CONST ANSWER=42;

FUNCTION DEEPTHOUGHT:INTEGER;
BEGIN
  DEEPTHOUGHT:=ANSWER;
END;

BEGIN
  WRITELN('THE ANSWER ... TO THE ULTIMATE QUESTION ...');
  WRITELN('OF LIFE ... THE UNIVERSE ... AND EVERYTHING ...');
  WRITELN('IS ... IS ... IS ... ',DEEPTHOUGHT,'!')
END.
```

Fig. 3. Not the ultimate program...

Hitch-Hiker's Guide to the Galaxy' will know, the answer is 42. We have cheated slightly by setting up the answer in a constant at the head of the program rather than working it out from first principles! However, this does save approximately 7,000,000,000,000 years.

That's a rather trivial example of a subroutine, but it does illustrate the way that functions are used in a program. The function-definition looks rather like a program — it consists of a header (saying FUNCTION instead of PROGRAM) and then some Pascal lines enclosed by the words BEGIN and END. The final END of a Pascal function or procedure should be followed by a semi-colon, not a full stop, otherwise Pascal will think that you have marked the end of the whole program.

The value of a function is passed back by storing it as if there was a variable with the name of the function. That's what the only statement in DEEPTHOUGHT is for. Pascal has a few rules about how this passing-back should be done. You only specify the name itself (not the part following in brackets). You must only assign (store a value in) the function-name — you are not allowed to use it on the right-hand side of a calculation, even if you have set it up earlier. That's necessary because it is sometimes useful to be able to call a function from inside itself (if you don't believe that, wait for next month's example program!). Pascal wouldn't be able to tell whether you were referring to the result so far or asking for the result of a new call.

SWAPPING AND TESTING

The program listed in Fig. 4 uses both a procedure and a function. The function is used to find out which of two integers is the greater. The procedure swaps over two integers.

Program BORINGSORT illustrates the way that Pascal 'renames' the numbers passed to a function — the function GREATEST(BIGGEST, OTHERONE) works even though the names of the parameters differ from the names used in the GREATEST routine. The routine doesn't care what the actual parameters are called — it sets up a local name NUM1 for the first one and NUM2 for the second and uses that instead. Consequently you could pass any two integers to the function. In fact the parameters don't even have to be variables — GREATEST(GREATEST(A+9,B), 34) would be allowed, assuming that A and B were set up as integer variables, functions or constants.

```
PROGRAM BORINGSORT(INPUT,OUTPUT);
VAR BIGGEST,OTHERONE:INTEGER;
FUNCTION GREATEST(NUM1,NUM2:INTEGER):INTEGER;
BEGIN
  IF NUM1>NUM2 THEN GREATEST:=NUM1 ELSE GREATEST:=NUM2
END;
PROCEDURE SWAP(VAR NUM1,NUM2:INTEGER);
VAR TEMP:INTEGER
BEGIN
  TEMP:=NUM1;
  NUM1:=NUM2;
  NUM2:=TEMP
END;
BEGIN (* THIS IS THE MAIN PROGRAM *)
  WRITE('PLEASE ENTER TWO NUMBERS ');
  READ(BIGGEST,OTHERONE);
  IF GREATEST(BIGGEST,OTHERONE)=OTHERONE THEN
        SWAP(BIGGEST,OTHERONE);
  WRITELN(BIGGEST,' IS AT LEAST AS BIG AS ',OTHERONE)
END.
```

Fig. 4. A program which uses both a procedure and a function: sorting and displaying two integers.

At first sight PROCEDURE SWAP is not possible. It is used to swap over the value of two variables — but we said earlier that variables set-up in a procedure or function vanish as soon as the routine reaches completion. We can't use a function to swap two variables since a function can only return one value.

The only obvious way of setting up the procedure is to set up two variables in the heading of the whole program (referred to as 'Global', since they aren't local to any particular routine) and to write a procedure to swap them over. You can still access variables set up outside from within a procedure, so this would work, but it would be rather pointless. The person calling the procedure would have to copy the variables to be swapped into the globals, call the procedure, and then copy the swapped values back again. This would mean four assignments and a procedure-call, whereas the swap could be written in three assignments!

Luckily Pascal does not force us to such an extreme. The procedure SWAP has the word VAR in its list of parameters. This has the special meaning that all the variables named between it and the next semi-colon are passed to the routine 'by address' rather than 'by value'. In other words the procedure doesn't make up two new variables and copy the value of the parameters into them — it just uses the addresses of the variables which contain the original parameter.

The VAR means that changes in the values of the variables in the procedure (NUM1 and NUM2) will also affect the corresponding variables outside it. In effect NUM1 and NUM2 become new, temporary names for the variables which were used to pass information into the routine. Theis means that you can only use a variable as a VAR parameter — for example SWAP(A+B,13) wouldn't work since it would imply (renaming NUM1 as A+B and NUM2 as 13) that the procedure should carry out the assignments A+B:=13 and 13:=TEMP, which is nonsense!

AVERAGES

A more complicated function might be used to work out the average value of a list of numbers. FUNCTION AVERAGE in Fig. 5 will do this.

This illustrates a strange rule. If an array is passed to a function a

definition of it must have been set up using the TYPE statement. You'd set an error if you tried to use "FUNCTION AVERAGE(NUMS: ARRAY [1..MAX] OF INTEGER):REAL;" to set up a function. Standard Pascal (rather annoyingly) requires that you delcare "TYPE LIST= ARRAY [1...MAX] OF INTEGER;" and then use "NUMS:LIST" to declare the parameter. In the long run this saves typing (at least two puns intended) but the rule really exists to make it easier for Pascal to check that you have passed the correct TYPE of variable to a function. When you call a function the types of the variables you specify in the call must match the types specified in the function-heading, otherwise Pascal could get in a terrible mess trying to store arrays in character-variables and REALs in BOOLEANs!

```
FUNCTION AVERAGE(NUMS:LIST):REAL;

VAR TOTAL,COUNT:INTEGER;

BEGIN

  TOTAL:=0;

  FOR COUNT:=1 TO MAX DO TOTAL:=
  TOTAL+NUMS[COUNT];

  AVERAGE:=TOTAL/MAX

END;
```

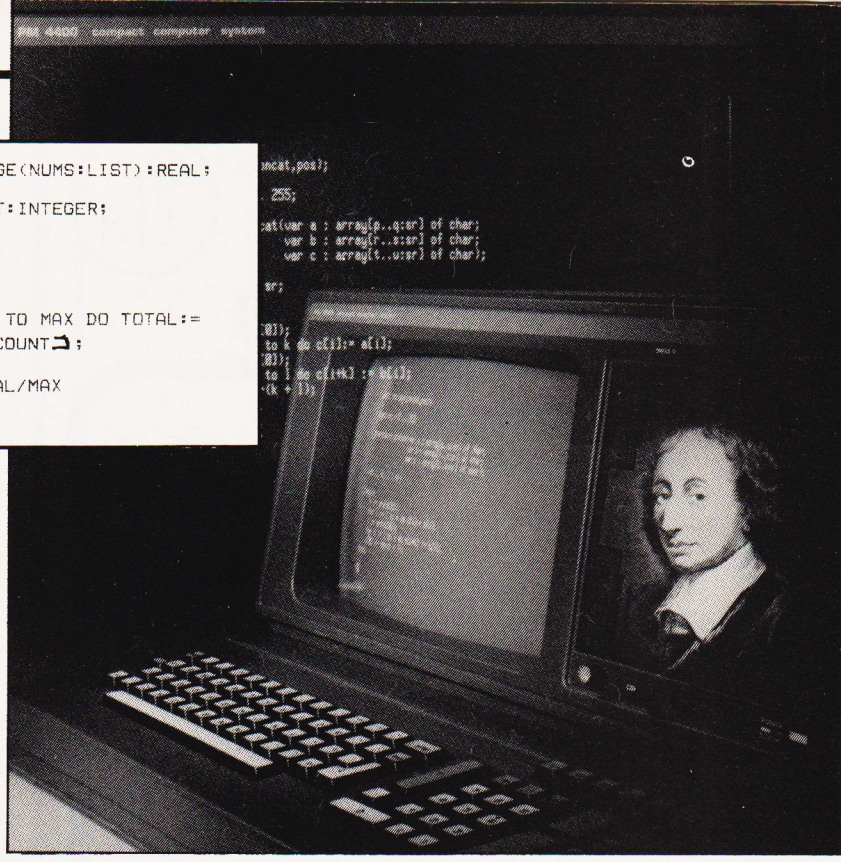

Fig. 5. A function to average a list of integers.

NEXT MONTH

In the last three articles we have explained most of the fundamental features of the Pascal language. Next month we will bring this series to a close with the complete listing of a small BASIC language interpreter, written in Pascal. The program illustrates the use of Pascal to break a complex program into a number of simple sections, and provides a detailed example of the use of Pascal. It also demonstrates the inner workings of a language interpreter similar to the one in most microcomputer ROMs. Whether you're learning Pascal or just reading these articles as a source of programming ideas, next month's article will be of interest.

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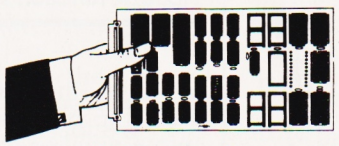

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SPECIAL REPORT

A daisy wheel printer at a quarter of the price you'd expect — sounds too good to be true!

Up until recently, printers of daisy wheel quality could not be bought for less than about £2,000. This effectively ruled out the use of micros and text processing from lots of applications in the home and small businesses. A 'letter-quality' printer was the most expensive single item in the system needed to use the new technology in the office, but without a printer of high quality there was no point in investing in the computer, discs and software. After all, however, accurately your documents are produced and however perfect their layout, if they appear with grainy type on poor quality listing paper nobody is going to be impressed. Small wonder that computer output documents have started to get a bad name if they typically appear with thin dotty print without true descenders (the tails on 'g's and 'y's). Up to now, if you could not afford a couple of thousand pounds, your best bet was to opt for a printer with an overlapping dot matrix. Now there is an alternative.

Smith Corona is a household name for typewriters, and their first venture into computer peripherals is a daisy wheel printer which combines the best of their existing technology with microprocessor technology. And the most important piece of news is that it costs £485 plus VAT.

Until the unit actually arrived, I remained sceptical that it was possible to market an acceptable daisy wheel printer at a quarter of the price I would have expected to pay. However, the proof of a product is in the testing and I've certainly put the TP-1 through its paces.

These days, office equipment is expected to be smart and the TP-1, while not being quite in the luxury liner category, has a neat, unfussy appearance. Its overall dimensions are approximately 7" high by 20" wide and 14" deep. The light grey parts of its case are in thick solid-feeling plastic, but the black panel at the front is thinner and less rigid. The hinged top flap is in clear smoke-grey plastic and this stands almost vertically when the unit is being used.

Inspecting beneath the covers reveals the real quality of the unit. It is good and sturdy with a die cast carriage. A fan is installed to keep it cool while operating. Even so, it is light enough to be portable if necessary, weighing less than 20lbs.

INITIAL SETTING-UP

In common with lots of other printers, the TP-1 is sold without an interface cable. Three options are available: serial, parallel and IEEE. A serial interface was requested, and supplied, for the review model. The manual that comes with the printer devotes two pages to describing the details of the serial interface, but these are not actually sufficient for practical purposes and the connection was finally achieved by guesswork. So much for doing things the hard way! Discom, the UK distributors who provided the review model, will supply a technical manual free of charge to anybody who requests one . . . I had only to ask for one to be posted! Alternatively, Discom are willing to make life easier by presetting the printer to your requirements. For example, there are 16 different baud rates available which are selectable by jumpers on the interface PCB. The default baud rate turns out to be 1,200, but this is the sort of adjustment that the distributors can make prior to delivery. When setting up the review model, it was necessary to connect the printer's 'clear to send line' (CTS) to prevent the buffer overflowing and garbled nonsense being printed out.

Setting up a unit with a parallel interface should be much easier and the manual appears to provide all the relevant information. The IEEE interface is a conversion unit which enables the TP-1 to be used with the PET or the Sharp.

EVERYDAY USE

Once set up the TP-1 is easy to use. Its on-off switch is at the back of the case below the fan housing and so a little awkward to reach from the front of the unit. The only other switch on the case sets the paper handling mode. There are two modes; 'normal' mode, for use with single sheets and 'top of the form' mode, for use with continuous stationery. In this mode the printer is sensitive to the ASCII 'FF' character and will advance to the top of the next sheet when it receives this signal. It is possible to set the size of a page and the size of the left- and right-hand margins under software control by sending particular ASCII codes.

Other operating controls are familar to anybody who has used a typewriter, and are easy to adjust. There is a line space selector which

has four positions: 1-six lines per inch; 1.5-four and a half lines per inch; 2-three lines per inch and 0-in which position the platten rolls freely. The 1 postition must be used in 'top of form' mode. There is also a control which determines the impact impression of the print wheel. This has five positions and the middle position is recommended for normal use and a higher position for use with multiple copy paper.

The manual states that multiple copy paper (specifically four-part forms), single sheet paper up to 13" wide and fanfold paper (the printer being initially programmed for paper 11" long) can be used, but that fanfold paper should only be used in conjunction with a tractor feed (an optional extra) that is supposed to be available. The review model had friction feed and, in fact, the feed mechanism was sufficiently good to enable continuous fanfold paper to be used as long as great care is taken to load the paper perfectly straight in the first place. If long lengths of paper start off at an angle they will quickly screw themselves up. When using continuous stationery with any friction feed system it is important to keep a watchful eye open for slippages, but during tests with the TP-1 no skewing or slipping occurred. It seems you can use fanfold paper with its friction feed system — as long as you don't intend to use whole boxes at one go!

The quality of the print produced by the TP-1 is good. It's crisp and clear and very pleasing. It is indistinguishable from typewriter output — and that seems to be the acid test for a higher quality printer. The only way to judge for youself whether you agree with my comments is to see a sample of its print.

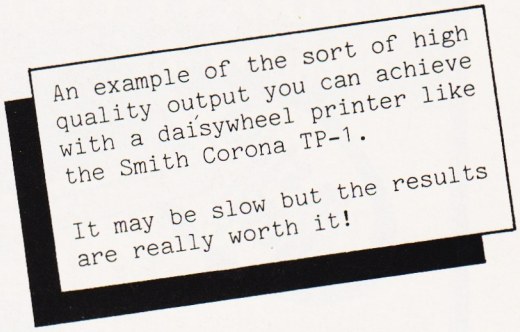
LOST IN SPACE

You may be wondering by now what features the TP-1 lacks. Well, it can't support proportional spacing, whereas some more expensive daisy wheels do, and it also lacks a 'self-test' feature — the ability to print out all its characters to reassure you it is working. However, it does have a 'self-protect' mechanism which will cut off the motor in the case of a disaster such as a paper jam. If you lift the cover on the TP-1 while it is printing, printing is suspended and not resumed until the cover is back in position, when it continues from where it left off. This might be useful if, say, you wanted to alter the position of the paper in mid-print. (Such action is not, however, recommended in the manual).

The daisy wheel itself is plastic but that is no criticism — it means that they are cheap to replace. (Replacement print wheels cost £7.50 plus VAT). The one that was supplied with the review model printed 88 characters, which sounds as though it should be sufficiently many. However, it is not. Unfortunately, it lacks greater than and less than symbols. This deficiency may, however, turn out to be a temporary problem. Changing print wheels is a simple task (and well explained and illustrated in the manual) and there are a variety of different fonts available in a choice of two pitches (or widths) — 10 characters per inch and 12 characters per inch.

One of the nicer features of this printer is its ribbon cassettes. These are simplicity itself to remove and insert and you need never come into contact with the actual ribbon — so no inky fingers! The review model was fitted with a film ribbon which certainly fulfilled its promise of a sharp image. Film ribbons can only be used once (those supplied for the TP-1 have a life of 57,000 characters) but fabric, multi-strike ribbons are also available (costing the same as the film ones at £1.90 plus VAT) and as they can be re-used many times, they therefore last at least four times as long. Their disadvantage, however, is that the image they produce deteriorates they are recycled.

The TP-1 prints at the rate of 12 characters per second. This means that it takes approximately three and a half minutes to print out a full single-spaced page of A4 paper. Whether this is fast enough depends entirely on your application. However, remember that as far as printers are concerned the higher the print quality the slower they print — and also the faster, the more expensive they become. All solid type printers are noisy to some extent and this one is no exception. It clatters in operation and goes through a whirring (both in sound and movement) routine when the power is first switched on. The noise it produces is, however, of a lower pitch than that from most dot matrix printers and some people may find this less disturbing. I did not find it any more or less noisy than other printers I have used. It does have a foam lining, for accoustic purposes, but this cannot eliminate all the noise by any means.



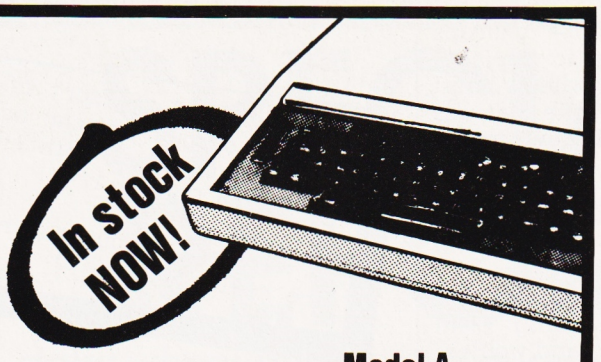
The output quality speaks for itself really!

QUALITY CONTROL

I liked the TP-1's quality so much that I found every opportunity to use the review model. Even so, after only a few weeks, I cannot really comment on its long-term reliability. Estimating, however, from the quality of its performance in the short term, I have every confidence in it.

On the whole, I am very impressed with the TP-1. The main thing that impresses me about it is its price. Its appearance opens up applications for micros which were previously ruled out because of the lack of high quality printer at reasonable cost. The TP-1 is by no means a poor relation to the family of daisy wheels. It can hold its own in terms of print quality and that is really what should count when it comes to making a choice. Smith Corona may have taken no short cuts on the essential features. The result is an efficient printer which produces results that anyone can be proud of seeing in black and white.

FACTSHEET	Smith Corona TP-1	
Printing speed	12cps	
Print width	up to 126 columns — 13"	
Method	Daisy wheel	
Paper handling	Single sheet feed Tractor feed optional	
Paper type	Plain	
Graphics	No	
Cost	TP-1	£557.75 inc VAT
Supplier	Discom Dresden House 51 High Street Evesham Worcestershire	



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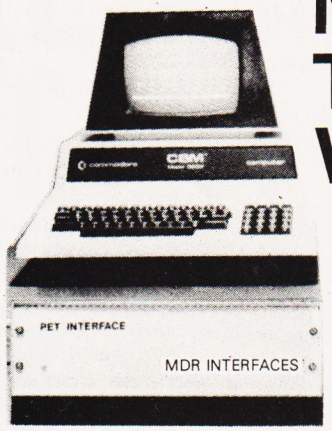

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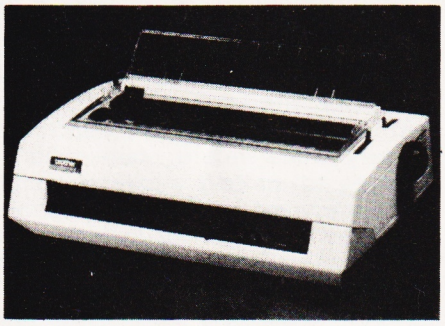

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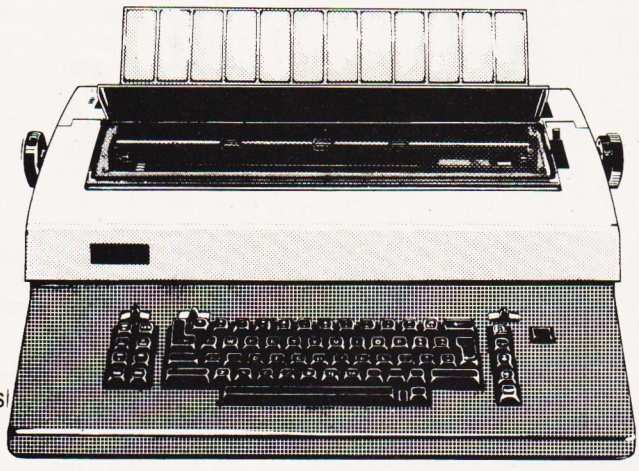

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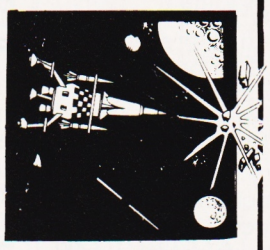

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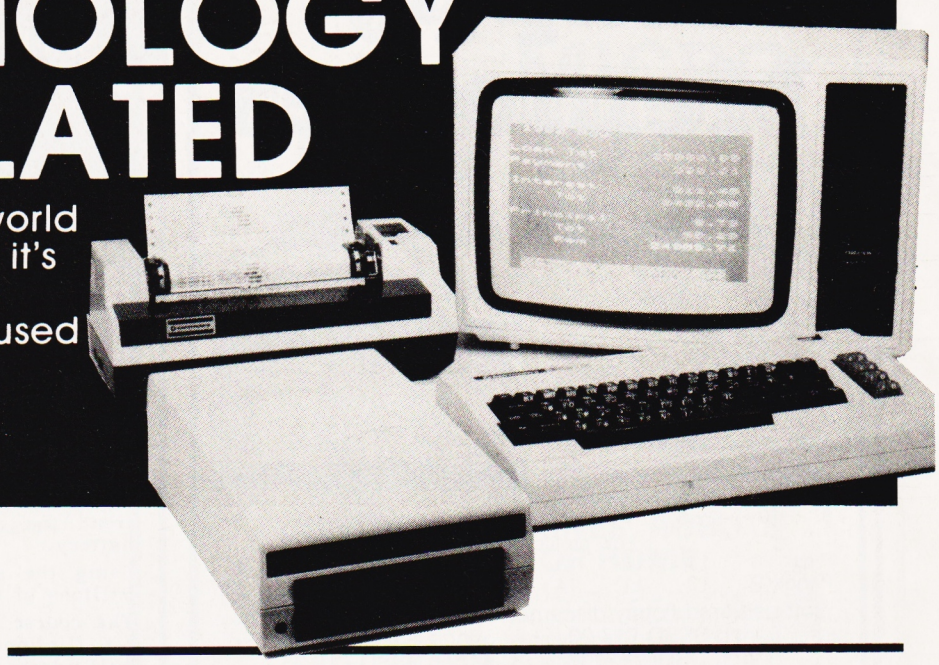


As the novice enters the world of computing he is bombarded by what appears to be a completely foreign language punctuated at monotonously regular intervals by mysterious acronyms.

In an attempt to help those of you who have been feeling somewhat bewildered by all the technical jargon surrounding the subject we have tried to explain here in simple English some of the more common terms in use.

COMPUTING COMPONENTS

Every single computer can be divided up into a number of fundamental segments, this not only makes them easier to understand but also helps us write about them in simpler terms!

The heart of each computer is the **Central Processing Unit** or **CPU**. On large computers this is a vast collection of circuits filling at least an entire printed circuit board and often an entire box. In the world of the personal computer, however, this has all been reduced into the space of a single integrated circuit, the **microprocessor**. This device contains all the necessary logic to take information in, process it according to a set of instructions and pass it back to the outside world. The speed at which it performs these operations is governed by two factors; first, the way in which the device has been made and second, the speed of the **clock**. The clock is simply a very accurate oscillator which beats millions of times a second; typical speeds are between 1 and 4 million cycles a second (this number is generally expressed as frequency — 2 MHz for example).

The actual logic contained within a microprocessor varies according to the technology available at the time it was designed, but suffice it to say that they are more complicated than I would wish to explain on these pages.

The simplest form of computer can be built from a set of switches, a microprocessor with its correct clock circuit, a power supply and a set of lights. If you set up the correct pattern of ons and offs on one set of switches, the device will take in the information presented as an **instruction**. The pattern of ons and offs represents a binary code, each on is regarded as a '1' and each off as a '0'. You could now give it some more information — **data** — then another instruction and, if you were lucky, you would see a **result** displayed on the set of lights. Systems such as this are often used in schools and colleges as basic training aids for students learning about microprocessors; they are not often found in the real world.

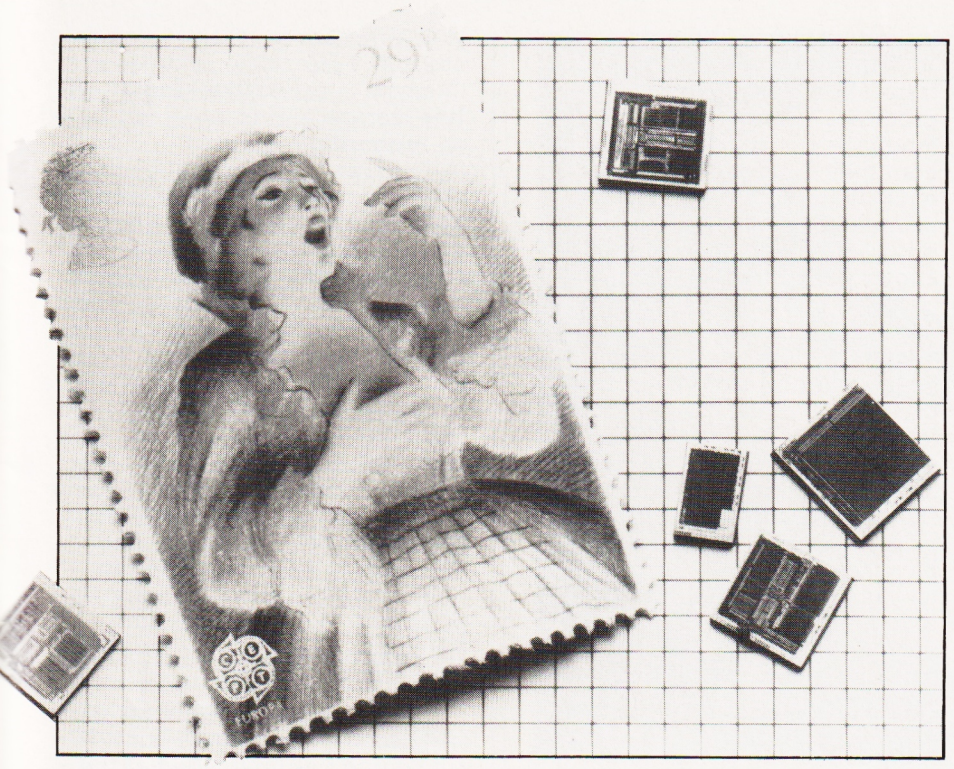
The set of instructions we give the computer is called the **program** and as we have been programming in the simplest possible form, **binary**, we call this **machine code programming**. It is often possible for the user of a microcomputer to program the system in machine code but we very seldom use the binary notation — remembering all those 0s and 1s is not easy. What is generally allowed, however, is the use of a code system called **hexadecimal, Hex** for short. This can be used because virtually all of the common microprocessors use **eight bits** to make up each of the instructions they use (eight bits is called a **byte** and this is the fundamental unit of information as far as the user is concerned). Hexadecimal means '16' so we are, therefore, working in base 16 arithmetic. This means that any eight digit binary number can be represented by two Hex digits. The letters A to F are used to represent the numbers 10 to 16.

ELEPHANT'S GRAVEYARD

It would obviously be very nice to store a set of Instructions — the program — somewhere in the computer rather than having to key them in one at a time. The breed of device we use for storage is called **memory** and this can be one of two fundamental types. These are commonly called **Random Access Memory** and **Read Only Memory**, that's **RAM** and **ROM** in the jargon, but these names do not really describe the true workings of their systems.

Random Access Memory comes in two types, **static**, which uses rather a lot of power but is very fast, and **dynamic** which uses less power but pays for this by being somewhat slower. As far as the user is concerned they are identical. Memory areas which are made up of RAM can be written to and read from; information can be stored and retrieved at the programmer's wish. However, if you turn off the power the contents are lost, fine for temporary information but not so good for programs.

The second type of memory,



The small wafers of silicon surrounding the stamp are the very latest from Hewlett-Packard, including their new 32-bit microprocessor.

ROM, comes in many guises but once the information has been stored it is there for good, the user can read it out when required but it cannot be destroyed by turning the power off. This sort of memory is used for all the programs which come built into the computer; these are the programs that you often don't realise are there, such as the program to take a character from the keyboard and the one which displays that character on the screen. All these hidden programs come under the general heading of the **Operating System** or **Monitor**. (The term monitor can also be used for a special type of visual display but in this case it is generally spelt with a small 'm').

All the information stored in memory is held in blocks of eight bits, the byte we mentioned earlier — and each byte corresponds to one single character. Most common computers use a coding system for the numbers and alphabet, and other special symbols called **ASCII** code which stands for the **American Standard Code for Information Interchange**.

Using the binary system where each of the eight bits (a bit is a BInary digiT just as 8 is a decimal digit) can be either 1 or 0, we can have a possible 2^8 combinations or patterns and as the full ASCII set only uses 128 of these, the manufacturers of microcomputers often add extra characters such as special graphics symbols.

The amount of memory a given microprocessor can use is limited by the number of **address** lines. A normal eight-bit micro, generally has 16 address lines and, using the same formula as the ASCII code, we can connect up to 2^{16} or 65,536 bytes of memory. This number is generally referred to as **64K** where the **K** signifies binary thousand or 1024. It is possible to connect more memory to a microprocessor using special techniques but only 64K of this total can be used at any one time.

PERIPHERAL PROLIFERATION

So far we have covered the central processor and the memory but we still can't actually use the computer because we have no way of getting information in or out. Devices such as keyboards and TV sets are the most common and these, together with their more exotic cousins, are all called **peripherals**.

As far as the typical personal computer is concerned, a **keyboard**, which looks somewhat like the one you would find on a typewriter but generally with more keys, is used for getting instructions and information into the computer. The computer's processed information, the program you are working on or anything else, is displayed on a **video screen**. This may be your domestic TV or a special video monitor or, in high-class systems, the screen and keyboard may be combined into a single unit called a **Visual Display Unit** or **VDU**. Some complete systems are built into what looks like a large VDU and these are often called **desktop** computers.

The type of display that you get on a TV or video screen varies from system to system but is typically expressed as so many **lines** of so many **characters**, 25 by 40 and 16 by 32 are typical. As well as the supplied graphics characters I mentioned earlier, some systems allow the user to produce true graphics; plot points, draw lines and so on. The capabilities of these systems is generally expressed as the number of **dots** that can be displayed across and down the screen. The larger the numbers, the higher the **resolution** you will be able to obtain. In practical terms this can be demonstrated by getting the system to draw a circle; the higher the resolution the nearer the result will be to a 'perfect' circle.

The keyboard and display are the two most vital components of the system, without them you can't use the computer. However, the computer is capable of being connected to much more exotic devices and the capacity for these connections is referred to as the **Input/Output** or **I/O**. Once again there are many different kinds of I/O connections, generally known as **interfaces** because they form the junction between two separate items. We can break these down into two groups, **serial** and **parallel**. The most common name associated with the former is the **RS232** standard which is used for many of the common peripheral devices such as printers, VDUs and even for connecting between two different computers.

The parallel interface is so called because it allows one entire byte to be transferred at a time, the serial interface transfers each byte bit by bit (that's not a pun either!). Two special sorts of parallel interface are frequently found, the **Centronics** printer interface and the **IEEE-488** communications interface.

In order to control the way in which information is passed over these interfaces, special control signals are used and these come under the delightful heading of **handshake** lines. The name describes their action exactly.

There is one further type of I/O which is fundamental to the computer and that is the **bus**. This is the collection of interconnections which allows various parts of the

computer to share sections of the processor. In many computers they are limited to the main processor board and the memory, but in more recent designs they are often gathered together in some logical order and brought out of the computer so the user may add extra facilities to his basic system. Names such as S-100, S-50, Eurobus, Multibus and a host of others can be found in the literature. In theory, if your computer has a defined bus structure then you can plug in any other extra, such as more memory, built to the same structure and it will work.

PROGRAMMING THE BEAST

Earlier in this piece I mentioned that writing programs in machine code (binary) or even their Hex alternatives was somewhat irksome. Well, on many systems you can have a special program fitted into the computer called an **Assembler**. This allows you to write your programs in **assembly code** where you use two-or three-letter words to represent the function you wish to be performed. These are called **mnemonics** and are translated by the assembler program into machine code which the computer can then run.

Programming the computer by these methods is laborious in the extreme and is generally avoided by providing the user with something called a **high-level language**. These are so called because they allow the user to express complex functions, which would otherwise require many hundreds of machine code instructions, in a language not dissimilar from English. The most common of these, at least as far as microcomputers go, is **BASIC**, which is the acronym for **Beginners All-purpose Symbolic Instruction Code**. You'll see a lot of it in its various forms between the covers of this magazine and it is relatively easy to learn and use. The main advantage that it has for the personal computer user is that it is an **interpreted** language; this means that you can easily change things around if they don't work or even improve those that do.

An **interpreter** is another program built into the computer which allows you to type in your programs in the high level language. The interpreter quite happily accepts this, stores it away and when commanded to RUN, sets about converting it all into machine code so that the central processor can actually do something with it. All this translation takes time and programs written in this sort of language run considerably slower than their machine code equivalents, so some computer manufacturers offer a special program called a **compiler**. This allows you to develop your program and thoroughly test it using the interpreter and then convert it completely into machine code. You now store away the old program and just use the much faster machine code version.

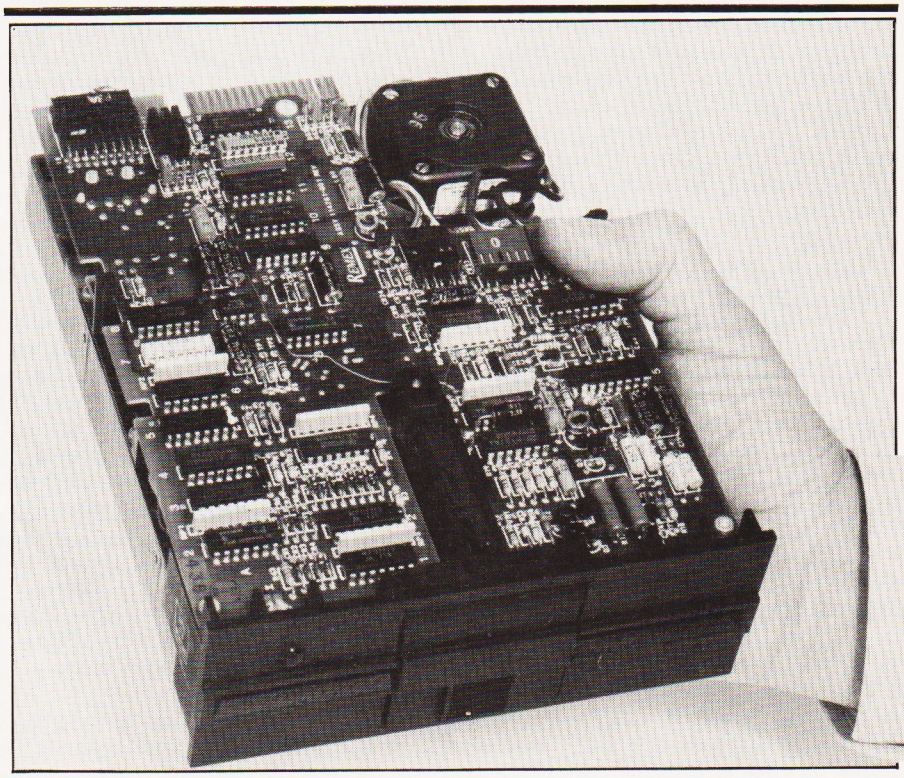
There are many programming languages; BASIC, Pascal, FORTH, COMAL, ALGOL, FORTRAN, etc, etc and they all have something to offer the user for his or her specialised use. Much argument has raged over good and bad programming techniques and which languages should be used for what but, in general, BASIC can still be regarded as the easiest to use and quickest to achieve results from.

KEEPING A COPY

All this talk of writing programs and a glimpse of the pages of BASIC and machine code in this magazine may have awakened a memory of something I mentioned earlier — RAM forgets when you turn the power off. What you really need is some way to store a copy of your program so that you can re-use it at a later date. Storage of this type is called **backing** or **off-line** storage and is generally based on **magnetic** recording techniques. The simplest and cheapest method is the **cassette tape**. In many cases you don't even need a special cassette recorder although digital-quality tape is to be recommended. The system works by converting each bit into one of two **tones**, a high tone if its a 1 and a low tone if its a 0. These are then fed, serially, on to the tape at a given speed. This speed is generally referred to as the **baud rate** but a more accurate definition would be the **bits per second** or **bps**. Obviously, the faster the transfer rate, the less time it takes to save or load your programs, but (relatively) the faster you save, the less reliable the process becomes.

The cassette comes in for much criticism for its slowness but it is unlikely to be superceded at the price for many years to come. The next step up the ladder is still tape-based and is called the **floppy tape** or **stringy floppy**. This is a much smaller and faster continuous loop rather like a miniature eight-track cartridge (remember those?). The real gain for the user is that the unit comes with an Operating System which makes it much easier to use.

Another step up the storage



Not only are they packing more onto floppy discs these days, they are even making them smaller. This is a slimline version of the popular 5¼" drive but you can now get 3½" alternatives.

ladder is the **floppy disc**. This comes in two sizes; **5¼"** and **8"** and is rather like one of those flexible gramophone records but made out of the same material as recording tape. This is enclosed in a cardboard envelope and spins round inside a **disc drive**. The information is stored in the disc in concentric rings called **tracks** each of which is broken up into a number of **sectors**. A basic single sided, single density 5¼" floppy disc holds about 200K of information; if you want more room you can go to double density or even quad density, but the remarks I made about fast storage on tape apply here too. Much better, if you can afford it, to use 8" drives and discs, these are the ones the professional systems use.

The Rolls Royce of storage media is the **Winchester disc**. These come in sealed boxes and replace one of your 5¼" or 8" drives. Because the discs inside are rigid, the tolerances to which the unit can operate are much higher and they can often store some 10M (megabytes) of information per 5¼" unit. The price of the unit, currently, is around £2,000.

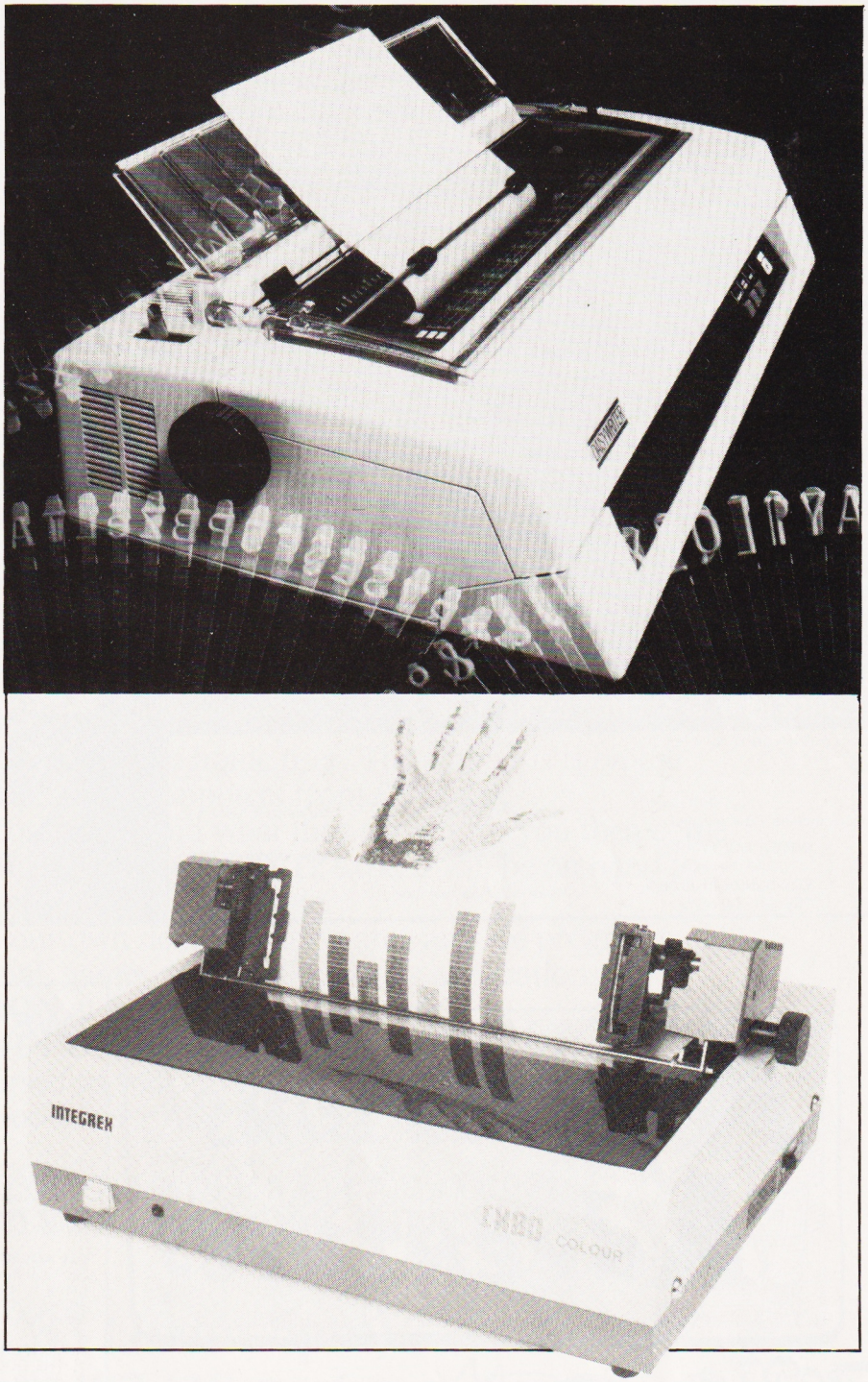
All of these discs have a sophisticated piece of software supplied called a **Disc Operating System** or **DOS**. Typical examples here include CP/M, FLEX and UNIX. These allow the programmer or user to issue a single command such as INITIALISE and the DOS will then perform a complete set of operations to prepare a new disc for use.

USING THE SYSTEM

All this stored information is very nice but only being able to read it on a TV screen is a little limiting, words on paper can be more use at times. The printed copy of something held on a computer is known as **hard copy** and you need a printer to get it. Printing devices can be broken down into two fundamental types and two methods of printing. The two types are **impact** and **non-impact**; this simply refers to whether the character is formed by banging something through a ribbon or whether it is created by thermal or electrostatic processes.

The methods most commonly found are **character printing**, this is where a complete character is formed on the paper at one go — just like on a typewriter — and **matrix printing**, where each character is made up from a number of dots. The best quality print comes from an impact character print and examples of these are the **daisywheel** and **golfball.** The daisy has the letters arranged around the rim of a slotted disc as compared to its close cousin the spinwriter, which uses a cup-like carrier for the letters.

Although the quality of text produced by a matrix printer is not quite as good as that produced by a character printer, it has the considerable advantage of being cheaper and more flexible to use. If you have a system which can produce special graphics characters then unless you want to spend a fortune on having special daisywheels or golfballs made, you need a matrix printer. Each needle of the matrix in the printing head can generally be controlled separately. This allows you to either have your own character set installed in a ROM inside the machine instead of, or in addition to, the one supplied with the machine; or even to control the needles as you are printing and so produce actual copies of the dots on the screen.



Daisywheel printers provide the sort of quality you expect from a good typewriter but they can be expensive and slow. Matrix printers are cheap and versatile, they can be used for graphics production too.

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CLUB CALL

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Here we are again with a bunch of groups all interested in gaining and sharing their knowledge about micros. If you do not see a club in your area why don't you start one and let us know about it?

SWANSEA COMPUTER CLUB
9 Yr Gorlan
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Contact: B J Candy
Tel: 0792-203811

Swansea is really hotting up as one of the country's main computer areas and the Swansea Computer Club is reflecting this interest. The club is still fairly young and it aims to organise lessons for beginners in BASIC which they hope to start in the near future. Anybody with an interest in computers is welcome and you don't have to own a computer to become a member. The club meets every Tuesday night from 6.00pm onwards at The Three Lamps, Top Floor, Castle Square, Swansea.

CANNOCK COMPUTER SOCIETY
20 Redwood Drive
Chase Terrace
Walsall WS7 8AS
Contact: Terry Sale

The Cannock Computer Society has been recently formed and meets fortnightly on Wednesdays at the premise of Cannock Computer Systems, Old Penkridge Road, Cannock. A wide range of micros were represented at the inaugural meeting in December, including the Sinclair ZX81 and ZX Spectrum, the VIC-20, BBC Micro, TRS-80, PET, Sirius and Dragon 32. The annual subscription is approximately £3.00 for adults, £1.00 for students and there is a small charge each meeting to cover refreshments etc.

EASTWOOD TOWN MICROCOMPUTER CLUB AND CTUK
Contact: Ted Ryan (Eastwood area)
Roger Hellings (Heanor area)
Robert Clifford (Underwood & Selston area)
Tel: 077-37 65011 (Ted Ryan)
077-37 69281 (Roger Hellings)
048-643 812459 (Robert Clifford)

This club has only recently started but is already expanding and now has two meetings a week at any of four venues: Devonshire Drive Junior School currently every Wednesday at 5.45pm; Eastwood Volunteer Bureau every Friday at 5.30pm or 6.30pm depending; or Upper School, Mansfield Road on either Wednesday or Friday when not at one of the above locations; or Sunnycroft, Scout HQ, Derby Road, when fund raising or when giving hands-on experience to Cubs and Scouts. One night per month is left open to the CTUK, usually the first Wednesday. Newcomers will be made welcome so contact any of the above members.

PONTYPOOL COMPUTER CLUB
Contact: Graham Loveridge
Tel: 049-55 2827

The club meets every Friday evening at the Settlement, Rockhill Road, Pontypool Gwent; anyone interested should contact Graham at the above number.

SOUTH NORTHANTS MICROCOMPUTER USER'S GROUP
83 Watling St. West,
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Contact: Simon Clark (Secretary)
Tel: 0327-52191

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Attention all VIC User Groups. The Nelson VIC Users Group wishes to make contact with other VIC user groups or clubs in order to establish a world-wide network or association of VIC user groups. They especially want to exchange VIC public domain software and club newsletters etc. The group has a variety of VIC software available for exchange including a number of excellent adventure games. Any clubs interested should contact the Group by airmail.

If you would like to let us know about your computer club we will endeavour to pass the information on. Don't forget to give us all the pertinent details like day and place of meetings, membership fees and restrictions, such as age, and if the club specialises in any particular machine or produces a newsletter.

If you want to be included on this page, write to us at:

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BOOK PAGE

There are computer languages other than BASIC and our reviewers have been taking a look at some of the books produced to support them.

BASIC is far and away the most popular programming language for micros but it is certainly not the only one and there are many reasons why you might wish to use a different language. For a start, you might wish to use a specialised language for a specialised application for which BASIC lacks the necessary commands. In this case you might look around for a language that enabled you to tackle the problem you were interested in. On the other hand, you might want to try another language simply for the fun of learning something new. Some programming languages have more intricate structures than BASIC; this in itself can be appealing if you enjoy an intellectual challenge. Or you might want to do so because other people had persuaded you to. There is a school of thought that maintains that BASIC is a load of rubbish and that you should be using XYZ language. In other words, there is a fashion element in computer languages, with each new language being hailed as the best ever, not-to-be-ignored answer to everybody's programming problems. The problem with this is that the dedicated follower of fashion will find themselves transferring to a new language every three to six months.

A couple of years ago Pascal was all the rage. If you look through back copies of *Computing Today*, then you'll find that the Book Page in the October 1981 issue was devoted to Pascal. Since then, of course, there have been lots of new titles, with still more promised, so we'll just mention four of them, more or less at random!

First on the list is a 532 page tome, **Pascal Program Development** by Kennedy and Solomon which introduces Pascal via a 10 instruction subset. Now this might make you think the authors had found an easy route to learning. In fact Pascal does not have many more instructions and what this book does is to postpone the introduction of Pascal's data structures, that is the aspect that makes Pascal a powerful language. However, as this book is intended for the complete beginner, this approach probably is the advisable one. Unfortunately, the fact that the book has been photoset from text processor output detracts from its readability. **Speaking Pascal** by Bowen is another book for the beginner. This takes rather an idiosyncratic approach to the subject — even to the point of illustrating the text with Victorian (we think) prints! However, it seems to cover the same ground as all the other standard texts and is certainly more readable than some of the alternatives. **Advanced Programming and Problem Solving with Pascal** is aimed at students who already know a programming language. It introduces the rudiments of Pascal in its first 50 pages and then goes on to teach programming style. It returns to data structures much later on and devotes a lot of space to this topic. Beer's **Programming Microcomputers with Pascal** is one of the first of the generation of Pascal books for micro owners. This in itself is a very welcome development but Beer's book, rather unexpectedly, is not one aimed at the personal computer owner, being very much geared to an academic audience. Well, we suppose that bent just about sums up Pascal!

Recently, the most talked-about language has been COMAL. In fact there is a link between it and Pascal that is more than their respective positions as 'fad' of 1980 and 'fad' of 1982. Since the attempt to get people to use Pascal in preference to BASIC has begun to run out of steam, with the vast majority of users still relying on BASIC irrespective of all the pressures to switch to Pascal, there's now a lot of interest in taking BASIC and extending it to include Pascal-like structures. Some of these modifications to BASIC have been rather gentle. For example, BBC BASIC includes a number of additions to bring it more in line with modern ideas about programming languages, but it still retains the essential spirit of BASIC and it's easy to use. If you already know BASIC you won't find the BBC Micro's version at all intimidating. However, there are other more radical approaches to this problem where, instead of just improving BASIC sufficiently to manage the job in hand, you virtually start from scratch and design a new language. One such language that adopts the approach of trying to fuse Pascal and BASIC is COMAL.

The problem with reviewing a book that deals with a new programming language is that it can be difficult to distinguish between the features and flaws of the book and those of the programming language itself. The book that deals with a new language is trying not only to teach you the language but is also trying

to promote it, by extolling its virtues.

Personally we find COMAL itself an interesting and useful language in that if you want to treat it mainly like BASIC you can and yet it still provides a helpful transition for the more advanced programmer to get used to Pascal-like statements and data structures. In some ways it might be better to consider COMAL as a version of BASIC as it really is not different enough to deserve a new name. However, trying to learn it via Roy Atherton's **Structured programming with COMAL** is something that we think would be rather difficult. Instead of being a direct introduction to the detailed aspects of the language, it tends to dwell on the more theoretical aspects of writing programs.

This can't really be taken as a criticism in view of the title which indicates that the book intends to teach programming methods and methodology and not simply the computer language COMAL but we fear that many a beginner will actually turn to this book to try and learn this relatively new language and be rather confused by the fact that it says a lot about structured diagrams, top-down analysis, stepwise refinement and the methodology of programming in general, rather than giving any details of COMAL. Given that the book is intended to appeal to a very wide readership, including personal computer users as well as teachers and students of computing science, it is a pity that Atherton chose to use COMAL, which most of his audience will come to as a new language, rather than BASIC or Pascal, as the vehicle for ideas about programming. Our overall opinion about this book was that it failed to have a coherent structure and seemed to be no more than a collection of random thoughts about programming methodology. It is not a book that will do COMAL any good.

FORTH can be considered as the fashionable language of 1981 but, like Pascal, it has found itself a niche and seems to be here to stay. Indeed, recent months have seen the advent of the Jupiter Ace, a micro that runs FORTH as its first language. FORTH is an unusual computer language, being something of a cross between an assembler and a high level language. It therefore provides the power and speed of an assembler while allowing programs to be written with relative ease. Leo Brodie's **Starting FORTH** aims to give the novice programmer an introduction to the language, while at the same time addressing the complexities that the experienced programmer will revel in. The newcomer will find this book a delight to read and easy to understand, but the experienced programmer will probably find the majority of it very slow. Our only other real criticism is that the examples seem more than rushed and give no insight into how a program is best developed in the language. Overall, though, we found the book to be one of the best available on FORTH, even if somewhat overpriced considering the wide audience it is aimed at.

Ada is a language that actually deserves all the attention it attracts. It is a new 'super' language commissioned by the US Department of Defence. They needed a language to replace FORTRAN, that all their programmers could use in the coming decades and so they financed several studies. The final outcome is a programming language named after Ada Lovelace (1815-1852) who was the daughter of Byron and the patron of Charles Babbage and also his assistant (and probably mistress too) in his work on his Difference Engine. As both the books reviewed here point out she was the first ever computer programmer.

Ada is an attempt to do better than any existing language. It should be seen as a successor to Pascal but rather than just being an extension to it, it belongs to the next generation of computer languages.

A note of caution is in order here. Because Ada has caused so much trouble, one thing you should be careful of is actually acquiring an Ada compiler on a microcomputer. Ada contains a subset that looks very like Pascal, a lot of the software houses simply took their Pascal compilers, changed the keywords and issued them as Ada compilers. In fact Ada contains a lot more than just re-written Pascal.

The Ada Programming Language by I C Pyle is relatively short and to the point and we found it the better of the pair of titles looked at this month, in that it quickly told us what we wanted to know. If you already know a programming language you'll find it makes the ideal handbook for making the transition. It includes notes for FORTRAN programmers and a discussion of all the elementary concepts that will already be familiar to Pascal programmers, and also some of the more advanced topics that will be completely new.

Programming Ada by J G P Barnes is wordier but probably more readable if you are at all shaky when it comes to Pascal. So if you are a beginner then we'd recommend this volume.

C is a computer language that is available on a number of microcomputers as well as larger machines. It has, however, never been subject to the same pressures of fashion as some of the others discussed in this review, appealing perhaps to a specialist elite. It is a high-level language, being similar to, but not the same as, Pascal. **The C Programming Language** by Kernighan and Ritchie is, like the language itself, not aimed at the novice programmer. Indeed, the experienced programmer will find the going tough without some experience of Pascal or a similar block-structured language. It rapidly moves into the complex programming facilities such as pointers, and, like most books dealing with that sort of area, goes too quickly. For the newcomer, the numerous 'improvements' to examples of code can prove confusing. In all, this is not a book that can be recommended for the novice, or for those whose experience is restricted to languages like BASIC. Programmers who are happy with Pascal and who are willing to stay the course, should, however, find it a good, if somewhat difficult, introduction to a powerful language.

The books included this month were:

Pascal Program Development, by Michael Kennedy and Martin B Solomon (1982), published by Prentice-Hall, 532 pages, £9.70

Speaking Pascal, by Kenneth A Bowen (1981), published by Hayden, 236 pages, £9.30

Advanced Programming and Problem Solving with Pascal, by G M Schneider and S C Bruell, published by Wiley, 506 pages, £7.35

Programming Microcomputers with Pascal, by M D Beer (1982), published by Granada £6.95

Structured Programming with COMAL, by Roy Atherton, published by Ellis Horwood, (1982), distributed by Wiley, 266 pages. £6.90.

Starting FORTH, by Leo Brodie (1981), published by Prentice-Hall, 348 pages, £12.75.

The Ada Programming Language, by I C Pyle (1981), published by Prentice-Hall, 293 pages, £9.95

Programming Ada, by J G P Barnes (1981) published by Addison-Wesley, 340 pages, £8.50

The C Programming Language, by Brian W Kernighan and Dennis M Ritchie (1978) published by Prentice-Hall, 219 pages. £12.75

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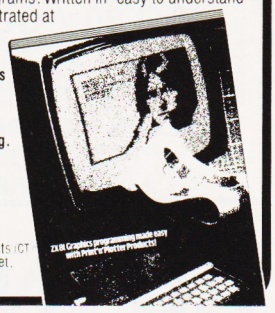

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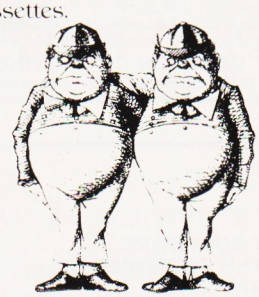

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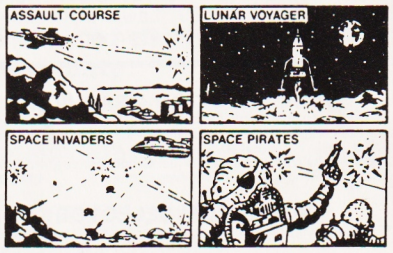

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CT STANDARDS

Our regular page explaining the meaning of the various symbols we use to make programs portable.

It has been very encouraging to see the number of programs submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this page is intended to set them out once again.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

CONTROL THAT CURSOR

Our original standards have now grown with the times. Machines such as the Commodore VIC which have a dual Shift capability can now be incorporated, as can those systems which use Control key functions.

The recently introduced BBC system offers pre-programmed function keys which, we are glad to say, can also be handled by our original coding system. It's nice to see just how well adapted the original standards have become over the last two years! (Indeed, a whole series of books is using them as its *de-facto* standard.) The standards for the cursor controls are given in Fig. 1.

headaches. This is really specific to the PET where the character set can be displayed in reversed video. On machines which don't have this facility you should either find a character in the set which is the reversed image of the one you want and use that or simply ignore it and use anything else you fancy! Don't forget, you may have to look up and alter the values used elsewhere in the program.

THE GRAPHIC SOLUTION

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphics symbols. The following standard is now in general use in programs published in *Computing Today*.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR$( ) codes) then they are indicated by the method shown in Fig. 2.

Several people have asked what the relationship between the POKE value for a character and that of its shifted graphic might be. In general the shifted version of any character will be 64 greater than the value of that character. This applies to both PET and MZ-80K systems in all cases.

[CLS]	CLear Screen
[HOM]	HOMe cursor
[CL]	Cursor Left
[CR]	Cursor Right
[CU]	Cursor Up
[CD]	Cursor Down
[REV]	REVerse video on
[OFF]	Turn it OFF
[SPC]	SPaCe
[CTL]	ConTroL key
[fn]	Function key (BBC)
[G<]	Graphic left (VIC/MZ-80A)
[G>]	Graphic right (VIC/MZ-80A)

Fig. 1. Our extended set of cursor control standards includes four new functions.

To indicate more than one of the above, an optional number can be placed within the brackets; [4 CL], etc.

The use of square brackets has raised one or two queries. The reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a Syntax Error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in the gap in the printout. The other common variant of the code for spaces is used by the ZX people. Their choice was '' and this crops up in the various newsletters they publish.

The code [RVS] has caused a few

This can be taken further to include machines which use a pixel graphics set rather than pre-programmed PET-style characters and the series of codes for these is given in Fig. 3. As is nearly always the case there is one machine to which the standard shown in Fig. 3 does not apply — Tangerine's Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 4, and is fortunately nice and simple.

MAKING REMARKS

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the documentation methods that we use is to keep our back-up copy of our programs on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

It is also good programming 'manners' to give your REMs odd line numbers:

```
3999 REM ** CRASH PROOF INPUT
4000 INPUT "THE NUMBER OF ENTRIES ";A
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. This can cause severe problems when re-numbering after removing the REMs.

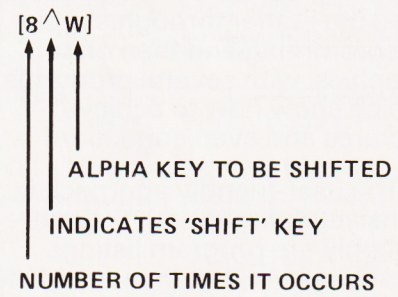

Fig. 2. The way we indicate block graphics on machines like the PET and Sharp. The VIC system of Shift Left and Shift Right is shown in Fig. 1.

1	2
4	8
16	32
64	128

Fig. 4. To convert a Tangerine pixel code into its blocks, simply decode the number into its binary or Hex value and fill in the relevant squares.

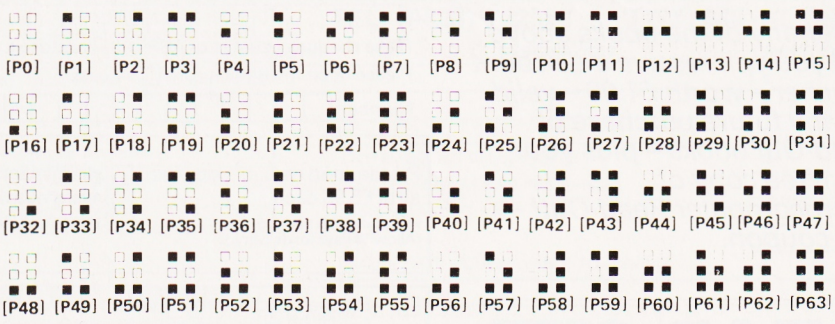

Fig. 3. The standard pixel codes; they will work on most computers which employ this technique as well as for Teletext and Prestel.

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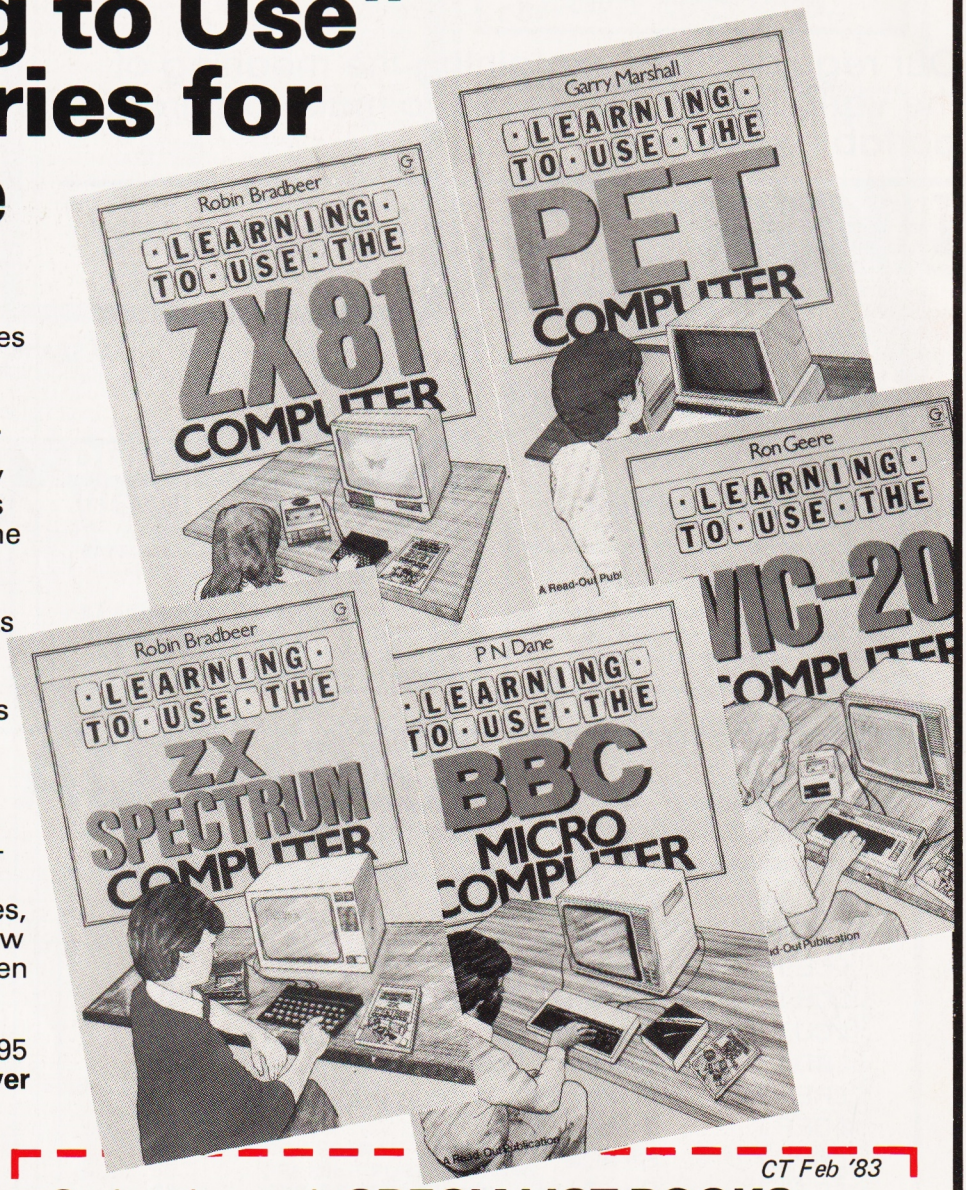

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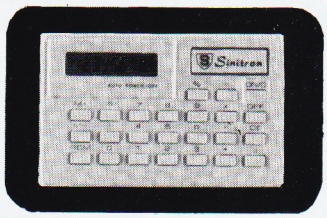

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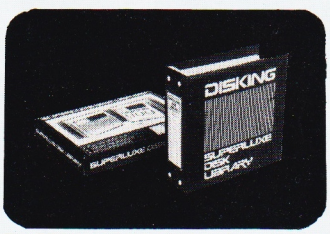

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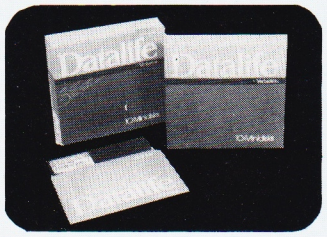

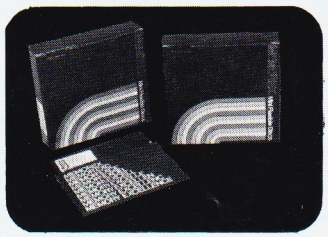

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ATARI 400 with 16K	**£199**
ATARI 400 with 32K	**£248**
ATARI 800 with 16K	**£349**

400/800 SOFTWARE & PERIPHERALS

Don't buy a T.V. game! Buy an Atari 400 personal computer and a game cartridge and that's all you'll need. Later on you can buy the Basic Programming cartridge (£35) and try your hand at programming using the easy to learn BASIC language. Or if you are interested in business applications, you can buy the Atari 800 + Disk Drive + Printer together with a selection of business packages.

Silica Shop have put together a full catalogue and price list giving details of all the peripherals as well as the extensive range of software that is now available for the Atari 400/800. The Atari is now one of the best supported personal computers. Send NOW for Silica Shop's catalogue and price list as well as details on our users club.

THE FOLLOWING IS JUST A SMALL SELECTION FROM THE RANGE OF ITEMS AVAILABLE:

ACCESSORIES
Cables
Cassettes
Diskettes
Joysticks
Le Stick - Joystick
Misc Supplies
Paddles

ADVENTURE INT
Scott Adams Adv
No 1 AdventureInd
No 2 Pirate Adv
No 3 Mission Imp
No 4 Voodoo Cast
No 5 The Count
No 6 Strange Ody
No 7 Mystery Fun
No 8 Pyramid of D
No 9 Ghost Town
No 10 Sav Island 1
No 11 Sav Island 2
No 12 Golden Voy
Angle Worms
Deflections
Galactic Empire
Galactic Trader
Lunar Lander
Mountain Shoot
Rearguard
Star Flite
Sunday Golf

AUTOMATED SIMULATIONS
Crush Crumble Cmp
Datestones of Ryn
Dragons Eye
Invasion Orion
Rescue at Rigel
Ricochet
Star Warrior
Temple of Apshai
Upper Reaches Aps

BOOKS
Basic Ref Manual
Compute Atari DOS
Compute Bk Atari
Compute Magazine
De Re Atari
DOS Utilities List
DOS2 Manual
Misc Atari Books
Op System Listing
Wiley Manual

BUSINESS
Calculator
Database Managemt
Decision Maker
Graph-It
Invoicing
Librarian
Mort & Loan Anal
Nominal Ledger
Payroll
Personal Finl Mgmt
Purchase Ledger
Sales Ledger
Statistics 1
Stock Control
Telelink 1
Visicalc
Weekly Planner
Word Processor

CRYSTALWARE
Beneath The Pyram
Fantasyland 2041
Galactic Quest
House Of Usher
Sands Of Mars
Waterloo
World War III

DYNACOMP
Alpha Fighter
Chompelo
Crystals
Forest Fire
Intruder Alert
Monarch
Moonprobe
Moving Maze
Nominoes Jigsaw
Rings of The Emp
Space Tilt
Space Trap
Stud Poker
Triple Blockade

EDUCATION from APX
Algicalc
Atlas of Canada
Cubbyholes
Elementary Biology
Frogmaster
Hickory Dickory
Inst Comptg Dem
Lemonade
Letterman
Mapware
Maths-Tac-Toe
Metric & Prob Solvg
Mugwump
Music Terms/Notatn
Musical Computer
My First Alphabet
Number Blast
Polycalc
Presidents Of U.S.
Quiz Master
Starware
Stereo 3D Graphics
Three R Math Sys
Video Math Flash
Wordmaker

EDUCATION from ATARI
Conv French
Conv German
Conv Italian
Conv Spanish
Energy Czar
European C & Caps
Hangman
Invit To Prog 1/2/3
Kingdom
Music Composer
Scram
States & Capitals
Touch Typing

EMI SOFTWARE
British Heritage
Cribbage/Dominoes
Darts
European Scene Jig
Hickory Dickory
Humpty Dumpty
Jumbo Jet Lander
Snooker & Billiards
Submarine Commdr
Super Cubes & Tilt
Tournament Pool

ENTERTAINMENT from APX
Alien Egg
Anthill
Attank
Avalanche
Babel
Blackjack Casino
Block Buster
Block 'Em
Bumper Pool
Castle
Centurion
Checker King
Chinese Puzzle
Codecracker
Comedy Diskette
Dice Poker
Dog Daze
Domination
Downhill
Eastern Front
Galahad & Holy Grl
Graphics/Sound
Jax-O
Jukebox
Lookahead
Memory Match
Midas Touch
Minotaur
Outlaw/Howitzer
Preschool Games
Pro Bowling
Pushover
Rabbotz
Reversi II
Salmon Run
747 Landing Simul
Seven Card Stud
Sleazy Adventure
Solitaire
Space Chase
Space Trek
Sultans Palace
Tact Trek
Terry
Wizards Gold
Wizards Revenge

ENTERTAINMENT from ATARI
Asteroids
Basketball
Blackjack
Centipede
Chess
Entertainment Kit
Missile Command
Pac Man
Space Invaders
Star Raiders
Super Breakout
Video Easel

ON LINE SYSTEMS
Crossfire
Frogger
Jawbreaker
Mission Asteroid
Mouskattack
Threshold
Ulysses/Golden Fl
Wizard & Princess

PERIPHERALS
Centronics Printers
Disk Drive
Epsom Printers
Program Recorder
RS232 Interface
Thermal Printer
16K Memory RAM
32K Memory RAM

PERSONAL INT from APX
Adv Music System
Banner Generator
Blackjack Tutor
Going To The Dogs
Keyboard Organ
Morse Code Tutor
Personal Fitness Prg
Player Piano
Sketchpad

PROGRAMMING AIDS from Atari
Assembler Editor
Dsembler (APX)
Microsoft Basic
Pascal (APX)
Pilot (Consumer)
Pilot (Educator)
Programming Kit

SANTA CRUZ
Basics of Animation
Bobs Business
Display Lists
Graphics Machine
Kids 1 & 2
Horizontal Scrolling
Master Memory Map
Mini Word Processor
Page Flipping
Player Missile Gr
Player Piano
Sounds
Vertical Scrolling

SILICA CLUB
Over 500 programs write for details

FOR FREE BROCHURES – TEL: 01-301 1111

FREE LITERATURE

I am interested in purchasing an Atari 400/800 computer and would like to receive copies of your brochure and test reports as well as your price list covering all of the available Hardware and Software.

Name .....

Address .....

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Postcode .....

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SILICA SHOP

For free brochure and reviews on our range of electronic products, please telephone 01-301 1111. To order by telephone, just quote your name, address, credit card number, and order requirements and leave the rest to us. Post and packing is FREE OF CHARGE in the UK. Express 24 hour delivery available at an additional charge.

- SHOP DEMONSTRATION FACILITIES – we provide full facilities at our shop in Sidcup, Monday to Saturday 9am to 5.30pm (closing Thursday 1pm, Friday 8pm).
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- PART EXCHANGE SECOND HAND MACHINES – we offer a part exchange scheme to trade in many makes of T.V. games for personal computers.
- COMPETITIVE PRICES – our prices, offers and service are very competitive. We are never knowingly undersold, and will normally match any lower price quoted by our competitors.
- HELPFUL ADVICE – available on the suitability of various computers.
- AFTER SALES SERVICE – available on all computers out of guarantee.
- VAT – all prices quoted above include VAT at 15%.
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